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VOL. 35. Ser. A. Part 6. pp. 169–200. JUNE, 1947.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 3s. net.

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Dias de Souza (H.). **A broca da cana de açucar e seus parasitos em Campos, Estado do Rio de Janeiro.** [The Sugar-cane Borer and its Parasites in Campos, State of Rio de Janeiro.]—*Bol. Inst. Exp. agríc.* no. 4, 22 pp., 8 pls., 9 refs. Rio de Janeiro, 1943. (With a Summary in English.)

Investigations were begun at Campos in May 1940, on the extent of the damage to sugar-cane by *Diatraea saccharalis*, F., and the possibilities of biological control. The variety of cane commonly grown in that district is P.O.J. 2878, and analysis showed that infested canes of this variety contained 8·96 per cent. less sucrose than healthy ones. The percentage infested in 1941 averaged 52·1, and this would correspond to a loss of 4·66 per cent. of the sucrose. Examination at harvest in 1940 and 1941 of both planted and first-year ratoon growth of various varieties showed that thick stemmed canes, such as P.O.J. 2878, were more heavily attacked than thin ones, and that the variety Co. 290 generally had the smallest percentage of infested canes and the highest content of sucrose. Infestation was less in ratoon than in planted canes, possibly because the former required less time to mature and were therefore exposed to attack for a shorter time. Canes on the outskirts of the plantations were more heavily attacked than those in the centre.

The parasites of the larvae of *D. saccharalis* found in the district were the Tachinids, *Theresia* (*Paratheresia*) *brasiliensis*, Tns., and *Metagonistylum minense*, Tns., which were the most important, the Braconids, *Agathis* (*Microdus*) *stigmatera*, Cress., and *Ipobracon* sp., and an unidentified Ichneumonid. Hyperparasites reared from the Tachinids comprised *Thysanus dipterophagus*, Gir., *Trichopria cubensis*, Fouts, *Pachycrepoideus dubius*, Ashm., and *Melittobia* sp. An unidentified species of *Megaselia* was predacious on the larvae of *Diatraea*. Throughout 1941, larvae and pupae of *Diatraea* and of the Tachinids were collected from infested canes and reared in the laboratory. The percentages of parasitism were calculated every month, and were found to range from 6·7 in April to 39·7 in August. Of the Tachinids that emerged in the laboratory, 82·6 per cent. were *Theresia* and the remainder *Metagonistylum*. The highest percentage of hyperparasitism observed was 7·5, in September, *Thysanus* and *Trichopria* being chiefly responsible.

Two consecutive generations of *Theresia brasiliensis* were reared in the laboratory. The females deposited their larvae 12–13 days after mating, at the opening of galleries of *Diatraea*. The larva enters its host through the skin between the segments ; when full-fed, it leaves the remains of its host and pupates near the opening of the gallery. The larval stage lasted 7–15 days, usually 9–11, and the pupal stage 22–27 days in spring, 14 days in summer and up to 29 days in winter. The emerging flies make their way towards the light, and pair within a few hours. A larva of *Diatraea* is not commonly parasitised by more than one larva of *Theresia*, as the females deposit only one in each gallery. A parasitised larva of *Diatraea* rarely attains the pupal stage.

For laboratory rearing, pupae of *T. brasiliensis* collected in the field were kept in wooden rearing cages having sides of glass and gauze, in which humidity was maintained by means of wet blotting-paper, but full-fed larvae were allowed to pupate in petri dishes with damp cotton wool on top. Adults were transferred to larger cages with sides of gauze, for pairing and were given sugar crystals or blotting-paper soaked in honey as food ; the atmosphere was kept damp by daily spraying with water. The flies paired more actively when the cages were placed in the light of a window. Fertilised females were removed to similar, smaller cages. Larvae were obtained from them after 12 days, either by dissection [*R.A.E.*, A **28** 651] or by the method employed by Scaramuzza [**28** 251], moistened petri dishes being used in place of a glass tube. This latter method is the more productive as the process can be repeated several times ; 133 larvae were obtained from one female by its use, and 44 from another by dissection. These 177 larvae were placed after 2–3 hours at the entrances of galleries

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containing larvae of *Diatraea*, in lengths of sugar-cane. Every four days, moribund hosts were removed to glass dishes where the parasites pupated, and these pupae were returned to the rearing cage. In all, 88 pupae were obtained, from which 51 flies emerged. From these a second generation was reared, the adults of which were released in the field. It is concluded that there is little likelihood of increasing the natural parasitism of *Diatraea* by so doing, because of the presence of the hyperparasites.

Chiesa Molinari (O.). **Entomología agrícola. Identificación y control de insectos y otros animales dañinos o útiles a las plantas.** [Agricultural Entomology. Identification and Control of Insects and other Animals harmful or beneficial to Plants.]—$9\frac{1}{2} \times 6\frac{1}{2}$ ins., 571[+2] pp., 510 figs., 282 refs. San Juan, Luiz, Ferrando y Cia. S.A., 1942.

This handbook on pests of plants of economic importance in the Argentine region of Cuyo, which comprises the western Provinces of San Juan, Mendoza and San Luis, consists of three parts. In the first, a brief account of the development and morphology of insects is given, with a glossary of the terms employed. The second consists of a systematic list of over 450 insects that either attack plants or are parasitic or predacious on those that do, with notes on their appearance, bionomics and distribution, and, in the case of the pests, their food-plants, the nature of the injury they cause and methods of control. In the third, other Arthropods (chiefly mites), Nematodes and vertebrates are dealt with similarly. There is an index to the scientific and common names of pests, and a list of plants showing the pests that attack them.

Soares (O. M.). **Algumas palavras sôbre os microcoleópteros prejudiciais ao arvoredo frutífero** (*Scolytus* **sp.).** [Notes on Microcoleoptera harmful to Fruit Trees (*Scolytus* sp.)]—*Bol. fitossanit.* **1** (1944) no. 2 pp. 137–138. Rio de Janeiro, 1945.

The author briefly reviews the habits of Scolytids that attack fruit trees and states that a species of *Scolytus* resembling *S. rugulosus*, Ratz., which is a serious pest in Argentina, is under investigation in the State of Paraná, Brazil.

Ferreira Lima (A. D.). **Os gafanhotos e suas invasões no Rio Grande do Sul.** [Invasions of Rio Grande do Sul by Locusts.]—*Bol. fitossanit.* **1** (1944) no. 2 pp. 139–145, 5 figs., 2 fldg. maps. Rio de Janeiro, 1945.

The author gives notes based on his own experience and the reports of other workers on the migration of *Schistocerca paranensis*, Burm., into the State of Rio Grande do Sul, Brazil, between 1933 and 1937. Most of the swarms came across the Argentine frontier, and though some appeared in districts along the Uruguayan frontier, all are thought to have originated in Argentina. Some reached the State of São Paulo and some fell into the sea, so that large numbers of locusts were washed up on the Atlantic beaches. In 1933 and 1934, the swarms were present only in November and December, respectively, but in 1935 flying locusts appeared in September, were reported from many districts in the southern part of the State, and did not disappear until March 1936. Oviposition and hatching took place in nearly 20 counties. Fresh swarms arrived in various places in August and September 1936 and oviposited, and hoppers were observed from early November onwards in most of the districts invaded. In that of Cachoeira, control operations were undertaken against the second-instar hoppers, and an account of these by J. H. de Carvalho is quoted. They included the use of a flamethrower, the spraying of vegetation with a mixture of arsenic, molasses and water, and, where the ground was not too rugged and stony, the digging of shallow trenches in which the hoppers

were collected and buried. In one district, 37 miles from the nearest lagoon and more than twice as far from the open sea, thousands of seagulls collected to devour the hoppers and also caught the adults in flight.

The areas invaded in 1935 and 1936 are shown on maps ; the damage done was considerable. No invasions were reported in the State after 1937.

BARBER (H. S.). **Notes on** *Cerotoma* **and** *Andrector* **(Coleoptera, Chrysomelidae).** —*Bull. Brooklyn ent. Soc.* **40** (1945) no. 4 pp. 121–122. Lancaster, Pa., 1946.

The author distinguishes *Andrector*, of which the type is *A. sexpunctatus*, Horn, from *Cerotoma*, of which the type, *C. caminea*, F., is synonymous with *C. trifurcata*, Forst., and briefly discusses the nomenclature of the three species of these genera that attack beans in the United States. They are *C. trifurcata*, which occurs in the eastern States, *A.* (*C.*) *ruficornis*, Ol., which is injurious in Texas and was found attacking the leaves and pods of lima beans in Florida in 1944, and *A. atrofasciatus*, Jac., which is a pest in Arizona, where it has erroneously been recorded as *C. trifurcata*. Outside the United States, *A. ruficornis* occurs in the West Indies and *A. atrofasciatus* is a pest of beans in Guatemala.

FREITAG (J. H.) & SEVERIN (H. H. P.). **Insect Transmission, Host Range, and Properties of the Crinkle-leaf Strain of Western-celery-mosaic Virus.**— *Hilgardia* **16** no. 8 pp. 361–370, 1 pl., 3 refs. Berkeley, Calif., 1945.

A mosaic disease of celery of which the symptoms resemble those of western celery mosaic [*Marmor umbelliferarum* of Holmes] but include severe crinkling of the leaves was first observed in the Santa Clara Valley of California in November 1937. It is not common and has been found only rarely during routine inspection of celery fields. The virus was transmitted mechanically to anise (*Pimpinella anisum*) and parsnip as well as to all the natural and experimental hosts of western celery mosaic [*cf. R.A.E.*, A **27** 590], but not to various other plants. Investigations on the properties of the virus and on its transmission by Aphids are described. Ten species of Aphids that breed on celery under natural conditions in California and the potato Aphid, *Macrosiphum solanifolii*, Ashm., all of which transmit the virus of western celery mosaic [*cf. loc. cit.*], were tested in batches as vectors, but only *Aphis ferruginea-striata*, Essig, *Myzus persicae*, Sulz., *M. circumflexus*, Buckt., *Macrosiphum solani*, Kalt. (*Myzus convolvuli*, Kalt.), *A. apigraveolens*, Essig, and *Hyadaphis sii*, Koch (*Rhopalosiphum conii*, Dvdn.) transmitted the virus. They did so to 26, 20, 12, 4, 4 and 2·9 per cent. of celery plants, respectively, whereas mechanical inoculation resulted in 84·7 per cent. infection. To determine how long the Aphids retained the virus, batches of *A. ferruginea-striata*, *Myzus persicae* and *M. circumflexus* were reared on infected celery plants, transferred to successive healthy plants daily for three days and left on the third lot of plants for a week. They infected 8·9, 8 and 12 per cent. of the plants on the first day and none thereafter.

From the results of the work, it is concluded that celery crinkle-leaf mosaic is a strain of western celery mosaic.

FREITAG (J. H.) & SEVERIN (H. H. P.). **Transmission of Celery-yellow-spot Virus by the Honeysuckle Aphid,** *Rhopalosiphum conii* **(Dvd.).**—*Hilgardia* **16** no. 8 pp. 373–384, 2 pls., 1 fig., 17 refs. Berkeley, Calif., 1945.

The author describes investigations carried out in 1935 on the yellow-spot disease of celery, which was first observed in the Santa Clara Valley of California during the summer of 1934. It is of little economic importance, as it causes only

slight stunting, and the spotted outer leaves are normally discarded in the harvesting of celery for the market. The virus was transmitted by *Hyadaphis sii*, Koch (*Rhopalosiphum conii*, Dvdn., *R. melliferum*, Hottes) from naturally infected parsnip and poison hemlock (*Conium maculatum*) to celery. It was not transmitted from celery to celery by Aphids of nine species, including *H. sii*, or by mechanical inoculation, but the symptoms on naturally infected celery were identical with those on celery experimentally infected by *H. sii* from infected poison hemlock and parsnip. No other plants were found naturally infected. The symptoms on celery are described in detail; parsnip showed a mild mottling of the leaves, and poison hemlock was a symptomless carrier.

In experiments in which winged and wingless adults of *H. sii* were reared on naturally infected poison hemlock and then transferred singly to healthy celery plants for one day, the winged Aphids infected 20 of 50 plants and the wingless ones only six of 50. Aphids of this species that were collected on naturally infected poison hemlock and transferred to healthy poison hemlock and celery infected 25·9 and 43·5 per cent. of the plants respectively, and others transferred to successive healthy celery plants daily for 6–23 days transmitted infection for 5–12 days.

FREITAG (J. H.) & SEVERIN (H. H. P.). **Poison-hemlock-ringspot Virus and its Transmission by Aphids to Celery.**—*Hilgardia* **16** no. 8 pp. 387–405, 4 pls., 34 refs. Berkeley, Calif., 1945.

In the course of attempts to find a weed reservoir of the virus of western celery mosaic [*Marmor umbelliferarum* of Holmes], poison hemlock (*Conium maculatum*) was repeatedly found infected with a ringspot virus in the Santa Clara, San Benito, Salinas and Sacramento valleys of California. Celery plants showing symptoms resembling ringspot were collected on several occasions, but attempts to recover the virus from these apparently naturally infected plants failed. Infected poison hemlock was heavily infested by *Hyadaphis sii*, Koch (*Rhopalosiphum conii*, Dvdn.), and in experiments this Aphid transmitted the virus to celery, celeriac, dill (*Anethum graveolens*), chervil (*Anthriscus cerefolium*), coriander, carrot, parsnip and parsley, from all of these to celery, and from celery to poison hemlock. Attempts to transmit the virus by mechanical inoculation from celery or poison hemlock to celery or from poison hemlock to poison hemlock were unsuccessful, but it was so transmitted from parsley to parsley in a small percentage of trials. The symptoms of the disease in the various plants are described.

Experiments in which the 11 species of Aphids found by the authors to breed on celery in California [*R.A.E.*, A **27** 590] were fed on infected celery plants for about a week and then transferred to healthy ones showed that all were capable of transmitting the virus, though *H. sii* was the most efficient vector. When individuals of two species that breed naturally on poison hemlock were tested singly, winged adults of *H. sii* infected 28 of 100 celery plants and wingless ones 16, whereas winged adults of *Aphis ferruginea-striata*, Essig, infected two of 100 and wingless ones 19. In tests with five species of Aphids that do not naturally breed on celery or poison hemlock, four of them failed to transmit the virus from infected to healthy celery and *Rhopalosiphum pseudobrassicae*, Davis, infected only one of 25 plants; none of these Aphids survived on celery for more than a few days. Attempts to transmit the virus by feeding individuals of *H. sii* for five minutes on diseased celery and then for five minutes on healthy celery were unsuccessful, and when groups of 25 examples of this Aphid were starved for 30 minutes and then fed for 5, 10 or 15 minutes on infected celery plants and for the same time on healthy ones, only 2, 3 and 2, respectively, of 100 healthy plants became infected. When groups of 25 were fed on diseased celery for an hour and then transferred hourly to nine successive healthy plants, most of them infected one or both of the

first two plants and then lost their infectivity ; no batch infected the last two plants. Similar results were obtained with groups reared on infected celery. When nine of the 11 species of Aphids shown to breed on celery were reared on infected celery in the greenhouse, transferred daily to three successive healthy celery plants and left on the last for a week, four species transmitted the virus on the first day only, five, including *H. sii* did so on the first two days, though the percentages of plants infected were very small on the second day, and none did so thereafter. Infected celery did not show symptoms for at least seven days, but *H. sii* recovered the virus from celery infected for only three days, though it acquired it more readily on the sixth and seventh day. It acquired it as readily 61–80, 121–140 and 181–200 days after inoculation as 2–21 days after.

KNOWLES (F. L.) & FISK (F. W.). **DDT Water Emulsion in Rice Fields as a Method of controlling Larvae of *Anopheles quadrimaculatus* and other Mosquitoes.**—*Publ. Hlth Rep.* **60** no. 35 pp. 1005–1019, 1 pl., 9 figs., 3 refs. Washington, D.C., 1945.

In the course of experiments made in Arkansas on the effectiveness of adding an emulsible DDT larvicide to the flooding waters at the pump for the control of mosquitos in rice-fields [*R.A.E.*, B **35** 87], examination of rice stools showed that there were about 50 per cent. fewer larvae of *Lissorhoptrus simplex*, Say, in a field treated with DDT in this way than in an untreated field. Also, many dead adults of this weevil were seen.

HASEMAN (L.). **Influence of Soil Minerals on Insects.**—*J. econ. Ent.* **39** no. 1 pp. 8–11. Menasha, Wis., 1946.

The results are given of preliminary experiments planned to determine whether insects reared on plants grown in nutrient solutions deficient in any of the essential soil minerals are affected thereby. A single series of experiments with the Colorado potato beetle [*Leptinotarsa decemlineata*, Say] did not give definite results, though there were variations in rate of reaching maturity and mortality. An experiment with the greenhouse whitefly [*Trialeurodes vaporariorum*, Westw.] showed that this Aleurodid thrives on *Petunia* grown on full nutrients, and that a shortage of either iron or potassium makes the plants unsuited for its normal development, but tomatos on full nutrients were less attractive to it than those grown on a medium lacking phosphorus or magnesium.

In more extensive investigations, *Toxoptera graminum*, Rond., was reared through 12 generations on wheat grown on full nutrients and on nutrients lacking one element. Shortage of phosphorus, potassium, magnesium or sulphur appeared to have no ill effects, and the individual Aphids actually produced more offspring for the first six generations than those on the full nutrients, indicating that as most damage is done during the first few life-cycles of an outbreak, the Aphid may be stimulated to greater crop destruction on land deficient in one of these minerals. When iron or nitrogen was deficient, the Aphid produced few offspring and survived for only a few generations. In a further test in which *T. graminum* was reared through seven generations, lack of nitrogen had serious effects, whereas the absence of calcium, phosphorus, potassium or magnesium had not, though there was some retardation of development. Individuals reared on plants grown on full nutrients matured and began to reproduce in an average of 232 hours and those reared on plants with deficiencies of calcium, potassium, phosphorus, magnesium and nitrogen in 272, 284, 297, 306 and 327 hours, respectively. Also, the average number of offspring for the first four generations was reduced from 33 to 32, 25, 26, 19 and 13, respectively. P. C. Stone found that the chinch bug [*Blissus leucopterus*, Say] on maize thrived and matured faster, lived longer and produced more

offspring when nitrogen was withheld from the nutrient solutions in which the plants were grown. The bug never attacks leguminous plants, and its need for sap lacking in nitrogen, rather than, as has been supposed, for a sunny environment, may explain field observations that it breeds more heavily on maize or small grain on thin eroded hillsides than in fertile valley soil and in dry seasons when the crops draw less on the soil minerals, including nitrogen, and also that maize is less severely attacked when planted with soy beans, which increase the nitrogen in the soil, and probably also in the sap of the maize.

These results, together with those of tests already noticed [*R.A.E.*, A **35** 56], indicate that insects may thrive best in the absence of certain minerals, that erosion, overcropping and faulty crop production improve conditions for insect pests [*cf.* **26** 666, etc.], and that more attention should be paid to the control of injurious insects by soil management.

LINSLEY (E. G.). **Insect Pollinators of Alfalfa in California.**—*J. econ. Ent.* **39** no. 1 pp. 18–29, 27 refs. Menasha, Wis., 1946.

Observations were carried out in four areas of California in 1945 to ascertain the insects responsible for the tripping and cross-pollination of lucerne. The results, which are given in some detail, showed that wild bees of the genera *Nomia*, *Melissodes*, *Megachile* and *Anthidium* were the principal agents, though the species were not the same in all areas. Honey bees were present in varying numbers in all the fields, but were less numerous and less effective as pollen-collectors than the solitary bees. Bumble bees (*Bombus* spp.), although individually more efficient than honey bees, were inferior to other wild bees and were usually not abundant enough to be regarded as important.

MARTIN (C. H.) & FINNEY (G. L.). **Factors involved in the Separation of *Macrocentrus ancylivorus* Cocoons from Tuber Worm Pupae.**—*J. econ. Ent.* **39** no. 1 pp. 29–35, 5 refs. Menasha, Wis., 1946.

When the technique of separating cocoons of *Macrocentrus ancylivorus*, Rohw., from pupae of *Gnorimoschema operculella*, Zell., by immersion in a solution of sodium hypochlorite and then in alcohol [*cf. R.A.E.*, A **34** 142] was adopted in the mass propagation of this parasite in California [*cf.* **32** 367], loss of parasites was caused by various factors.

Mechanical injury involved in the sifting of sand from the cocoons of *Gnorimoschema* to prevent it from accumulating in the hypochlorite solution was reduced when the ½–1 in. layer in the cocooning trays, only the upper part of which usually had cocoons in it, was replaced by adjacent ridges of sand 2 ins. wide and ⅜ in. high at the peak of the ridge, in which the larvae formed cocoons at the bottom as well as the top, and produced a mat of cocoons with little or no excess sand. Mechanical injury sustained when the parasite cocoons and host pupae were transferred from the hypochlorite solution to the alcohol and water baths was eliminated by using a wire-mesh basket in which they were immersed first in the hypochlorite solution, then in tap water and finally in alcohol; during the final immersion, trap doors in the base of the basket were opened to allow the host pupae (and any host and parasite larvae present) to sink into a larger basket. The cocoons were dried quickly before an electric fan, but the host pupae could be allowed to accumulate in the alcohol for an hour before being dried without apparent effect on the emergence of the moths. They could be separated from host and parasite larvae in a used solution of sodium hypochlorite, in which the larvae sank, but the pupae floated.

While stable solutions of sodium hypochlorite and water at concentrations as high as 1 : 3 did not affect either the host or the parasite, provided that these were rinsed afterwards, decomposing solutions increased the mortality of *M. ancylivorus* from 5–25 to 20–86 per cent. Decomposition began after certain

quantities of organic materials had collected in the solution and its occurrence was shown by an increase in the time of disintegration of host cocoons from 25 to 30–60 seconds, by a rise in temperature, and by the liberation of sufficient chlorine to irritate the eyes and throat of the operator. Experiments showed that it was the free chlorine that injured the insects.

Mortality of *M. ancylivorus* due to immersion in alcohol depended on the specific gravity of the solution ; it differed little from that of untreated cocoons when the specific gravity was 0·900–0·930 (Baumé [U.S. formula]), but was four times as high when it was 0·840–0·855. In the insectary, a solution with a specific gravity of 0·920 caused more efficient separation than one of 0·930.

As host pupae that are approaching maturity float in the alcohol solution, it is necessary to separate the parasite cocoons from them before they reach this stage, and this results in the loss of some parasites that have not spun their cocoons. One of the causes of delay in the formation of cocoons was superparasitism, and this was reduced by exposing the hosts to the parasites for three days instead of five. Freeing and separating the parasites was best carried out when the host cocoons had been kept at 84°F. for 6–7 days after their formation, because prepupae and young pupae of the parasite suffer more mortality during the process than the older pupae.

ROARK (R. C.). **Feeding Chemicals to Plants and Animals for Pest Control.**—*J. econ. Ent.* **39** no. 1 pp. 35–38, 12 refs. Menasha, Wis., 1946.

The second part of this paper [*cf.* also *R.A.E.*, B **35** 88] consists of a review of the literature on the introduction of chemicals into the sap stream of plants in order to kill insects feeding on them. Many attempts to control insects attacking growing trees by the injection of chemicals have been unsuccessful, either because the compounds were toxic to the trees or not toxic to the insects ; other possible reasons for failure are that the compound may be precipitated in the sap stream and fail to be distributed, that it may be distributed in an altered, non-toxic form, or that the dosage applied may be too low. Several compounds have been found effective in killing bark-beetles or other insects and preserving wood, but not in maintaining the tree in a healthy growing condition [*cf.* A **28** 335, 336 ; **34** 56]. The apple-grain aphis [*Rhopalosiphum prunifoliae*, Fitch], feeding on wheat, rye, oats and barley, was killed by selenium taken up by these plants from small amounts of sodium selenate added to cultures or soils [*cf.* **24** 768], and the constituents of derris powder, applied to the first true leaves and stems of bean plants and translocated to the first, second and third trifoliate leaves formed later, retarded the feeding of larvae of the Mexican bean beetle [*Epilachna varivestis*, Muls.] on them [**25** 287 ; **26** 332]. The translocation of derris constituents indicates that tests of chemicals for injection into plants need not be limited to those readily soluble in water.

IVY (E. E.) & EWING (K. P.). **Benzene Hexachloride to control Cotton Insects.**—*J. econ. Ent.* **39** no. 1 pp. 38–41, 1 graph, 2 refs. Menasha, Wis., 1946.

The results are given of laboratory tests carried out in Texas in 1945 to compare dusts of benzene hexachloride with other insecticides for the control of seven of the more important insects attacking cotton. The compound diluted with talc to contain 10 per cent. of the active γ isomer was used unless otherwise stated ; this dust was further diluted with pyrophyllite when lower concentrations were required. When the rate of application was 8 lb. per acre, the benzene-hexachloride dust and calcium arsenate caused 20 and 6 per cent. mortality, respectively, of adults of *Anthonomus grandis*, Boh., after one

day and 79 and 70 per cent. after five days. The same dusts, applied at the same rate, caused 56 and 32 per cent. mortality of third-instar larvae of *Alabama argillacea*, Hb., after one day and 98 and 96 per cent. after five, but lower concentrations of benzene hexachloride were much less effective. Mortality of both these insects was increased by increasing the rate of application of benzene hexachloride to 16 or 32 lb. per acre. This dust at 8, 16 or 32 lb. per acre was less effective against third-instar larvae of *Heliothis armigera*, Hb., than either 5 per cent. DDT in pyrophyllite or calcium arsenate applied at 16 lb. per acre. Benzene hexachloride diluted to contain 5 per cent. γ isomer and 4·6 per cent. DDT in sulphur both gave complete kill of adults of *Lygus oblineatus*, Say, in one day, and a dust containing 1·25 per cent. γ isomer caused complete mortality of adults in three days and of nymphs in five, all when applied at 16 lb. per acre. The benzene-hexachloride dust was about as effective as 10 per cent. DDT in pyrophyllite against *Nezara viridula*, L.; both gave good control of second-instar nymphs, fair control of adults and poor control of fifth-instar nymphs at 16 lb. per acre. Benzene hexachloride at concentrations of 1·25–10 per cent. γ isomer and 4·6 per cent. DDT in sulphur gave complete or almost complete mortality of adults of *Psallus seriatus*, Reut., in a day at a rate of 16 lb. per acre; 5 per cent. DDT in pyrophyllite at the same rate gave 61 per cent. mortality, and benzene hexachloride at a concentration as low as 0·31 per cent. γ isomer gave 83 per cent. The benzene-hexachloride dust applied at 10–40 lb. per acre was more effective against *Aphis gossypii*, Glov., than 2 per cent. nicotine in calcium arsenate. In field-cage tests, at 10 lb. per acre, benzene-hexachloride dusts containing 5 or 10 per cent. γ isomer gave better control than the calcium arsenate and nicotine one day after treatment, whereas those containing 2·5 and 1·25 per cent. were less effective, but four days later, the control from all concentrations of benzene hexachloride was better than that from calcium arsenate and nicotine.

In field-plot tests, in which cotton planted in August was dusted on 17th October, the benzene-hexachloride dust applied at 11·6 lb. per acre reduced the populations of adults of *Anthonomus grandis* by 59 per cent. in two days, whereas calcium arsenate containing 2 per cent. nicotine applied at 17·2 lb. per acre caused no reduction. The numbers of *Aphis gossypii* one, two and five days after application of the dusts were, respectively, 65, 67 and 77 per cent. lower on the plants treated with benzene hexachloride and 23 and 21 per cent. lower and 8 per cent. higher on those treated with the nicotine and calcium arsenate.

Injury to tender terminal leaves was observed after heavy spotted applications of benzene hexachloride in two cage tests. No injury was observed at concentrations below 10 per cent. or at rates of application lower than 16 lb. per acre.

Snapp (O. I.). **DDT to control Bugs that cause deformed Peaches.**—*J. econ. Ent.* **39** no. 1 pp. 41–43, 1 fig. Menasha, Wis., 1946.

Considerable percentages of the peaches in orchards in South Carolina, especially in Spartanbury County, are unsaleable because they are scarred and distorted as if by bugs, and observations in 1944 howed that *Lygus oblineatus*, Say, was present on the trees from full-bloom to petal-fall [*cf. R.A.E.*, A **35** 84] in orchards that had produced many defective peaches in previous years, but was not found in one that had produced chiefly sound peaches. Pentatomids were present in only very small numbers. It is concluded that the Mirid was chiefly responsible for the injury.

A spray containing 1 lb. DDT per 100 U.S. gals. was effective against *L. oblineatus* in cage tests in the spring of 1944, and one application of 5 per cent. DDT in pyrophyllite and kaolin alone or followed by one or two of 10 per cent. DDT in pyrophyllite in March–May reduced the percentage of peaches damaged from

14·6 to 5·9, 5·2 and 3·5, respectively, as compared with 10·3 on trees that were jarred 16 times between 22nd March and 15th May. In large-scale tests in 1945, single applications on 13th or 15th March, when the trees were in full bloom, of 5 and 10 per cent. DDT dusts at the rate of about 0·2 lb. per tree or of a spray of 1 lb. DDT and 1 oz. sodium lauryl sulphate per 100 U.S. gals. and one at double this strength, applied at the rate of 6 U.S. quarts per tree, reduced the percentage of peaches damaged at harvest from 42·4 to 7·8, 10·7, 11·8 and 11, respectively.

These results are considered very promising, but since the application of DDT to trees in blossom may endanger bees and other pollinating insects, applications just before the trees flower are planned for future tests. Thinning the fruit did not affect the control given by 5 per cent. DDT dust.

Cottam (C.) & Higgins (E.). **DDT and its Effect on Fish and Wildlife.**—*J. econ. Ent.* **39** no. 1 pp. 44–52, refs. Menasha, Wis., 1946. **Correction.**—*T.c.* p. 295.

The results are given of observations made in various parts of the United States and in Ontario in 1945 on mortality of animals caused by DDT applied from aircraft for the control of insects. The principal investigations were made where insects attacking forest trees were the object of control, but some were made on the effect of DDT applied against insects attacking crops. The DDT was applied chiefly in oil solutions at concentrations that gave rates of 0·2–5 lb. per acre, but the amount of DDT that actually reached the vegetation showed considerable local variation from the specified rate of application, owing to bad weather, lack of landmarks, defective spray apparatus and different densities of vegetation. Most of the higher concentrations caused pronounced mortality of wild animals, whereas most of the lower ones had little or no effect; but invertebrates and cold-blooded vertebrates were more readily affected than birds and mammals, and all concentrations caused mortality of fish. In two cases, DDT was applied as a dust, at rates of 25 and 1·5 lb. per acre, respectively. The higher rate caused noticeable mortality of birds, but the lower one did not.

In experiments, DDT was found to be much more toxic to birds in vegetable oil solution than in the crystalline form and to fish in emulsions than in oil solutions; very few fish were killed by a suspension of DDT and none by feeding on insects killed by DDT.

On the basis of these results, the authors recommend that DDT should not be used without due consideration. It should be applied at the minimum effective dosage, not in emulsions and at less than 0·2 lb. per acre in oil solution to avoid damage to fish, crabs or crayfish and at less than 2 lb. per acre to avoid damage to birds, amphibia and mammals in forest areas. It should be applied evenly, only in calm dry weather and only where it is needed. In forests, treated and untreated strips should be alternated in order to disturb animals as little as possible, and the DDT should be applied just before the appearance of leaves and the main spring migration of birds to control insects that appear early in the season, and after the nesting season, which lasts to the middle of August, against late insects. DDT should not be applied directly to streams, lakes and coastal bays, because of the susceptibility of fish and crabs.

Lindquist (A. W.), Jones (H. A.) & Madden (A. H.). **DDT Residual-type Sprays as affected by Light.**—*J. econ. Ent.* **39** no. 1 pp. 55–59. Menasha, Wis., 1946.

An account is given of experiments noticed more fully elsewhere [*R.A.E.*, B **35** 90] in which the deposits left by various DDT sprays were exposed to an ultra-violet lamp or to direct sunlight and then tested against house-flies (*Musca domestica*, L.). The results showed that DDT is more rapidly

decomposed in solution than as a solid deposit, and the loss of toxicity was greatest for sprays incorporating high-boiling solvents, which maintained the DDT in solution for considerable periods. Deposits from solutions were more seriously affected than those from emulsions or suspensions.

DAVIS (J. J.). **DDT to control Household and Stored Grain Insects.**—*J. econ. Ent.* **39** no. 1 pp. 59–61. Menasha, Wis., 1946.

In this survey of the effect of DDT on household insects [*cf.* also *R.A.E.*, B **35** 91] and insects that attack stored products, the author states that seeds and grain are adequately protected against the common insects that attack them by the proper application of DDT, that its use with a carrier or diluent gives satisfactory distribution over the seed, and that it can be combined with various seed disinfectants for treatment against both insects and seed-borne diseases. It has no harmful effect on germination, but should not be applied to seed or grain that is to be used as food for man or domestic animals. In laboratory tests, some of which have already been noticed [*cf.* A **32** 377, 378], wheat treated with 0·005, 0·025 or 0·05 per cent. DDT by weight was protected for at least a year, and contained many dead adults of the lesser grain beetle [*Rhizopertha dominica*, F.] and *Tribolium castaneum*, Hbst., and dead larvae of *Tenebroides mauritanicus*, L., and the Indian meal moth [*Plodia interpunctella*, Hb.], and wheat, barley, oats and sorghum seed treated with 3 per cent. DDT dust at rates varying from 0·05 to 0·1 per cent. by weight showed no infestation eight months later. Insects that attack stored grain were destroyed by the application of 5 per cent. DDT in oil, emulsions, or in wettable form to the walls and woodwork of warehouses, flour mills and empty grain bins.

Investigations on the silverfish [*Lepisma saccharina*, L.] and firebrat [*Thermobia domestica*, Pack.] indicate that they can be effectively controlled by dusting or spraying the sources of infestation with 5 per cent. DDT. It has been shown that fabrics containing 2 per cent. or more of their weight of DDT are protected from clothes moths and carpet beetles, though it is probable that other chemicals are equally valuable, and no chemical treatment is so effective as cleaning up breeding places, dry cleaning and proper storage. A spray containing DDT, applied to places in which lint accumulates and carpet beetles breed, has given good results. The use of aerosols in closed spaces kills clothes moths but has no effect on their larvae in the folds of fabrics.

DDT powder has given protection for two weeks and DDT sprays for four weeks when used as a barrier against various species of ants, but is less effective than poison baits. *Dermestes lardarius*, L., and similar beetles breed abundantly round incinerators in which the destruction of refuse is not complete, and they should be controlled by more efficient burning, but it was observed that 1 per cent. DDT in kerosene killed larvae and adults when applied directly to them and that the deposit from such a spray is effective but requires several days to take effect.

WHITEHEAD (F. E.). **An effective Method of controlling Codling Moth in Oklahoma Orchards.**—*J. econ. Ent.* **39** no. 1 pp. 69–76, 1 fig., 5 refs. Menasha, Wis., 1946.

This is a preliminary report of observations carried out in 1943–45 to determine whether the codling moth [*Cydia pomonella*, L.] could be controlled in Oklahoma, where the typical summer weather is very favourable for its development, by planting orchards in which all the apples mature and are harvested before the larvae enter hibernation. Most of the work was done in a single orchard containing varieties ripening at all periods between late June and early October ; records were taken of the numbers of larvae that entered hibernation on the different varieties and the dates by which they had done so, and some

less complete records were made in other orchards in 1944 and 1945. The results are detailed in tables, and it is calculated from them that only about 9 per cent. of all the larvae that hibernated had formed their cocoons by 15th August and that of the total population hibernating on equal numbers of trees that matured their fruit before and after this date, less than 2 per cent. are on the former. The reason for selecting 15th August as the date to consider was that it is late enough to permit the harvesting of a variety (Summer Champion) that has given the best yield of all the varieties grown in the experimental orchard, and several days elapse before other desirable varieties reach maturity. It is concluded that planting orchards in which no trees mature later would greatly reduce infestation by *C. pomonella*, and would be practical as early apples are more economically produced and normally bring higher prices.

PIERCE (W. C.). **Timing Spray Applications to control the Pecan Nut Casebearer.**—*J. econ. Ent.* **39** no. 1 pp. 76–78, 2 refs. Menasha, Wis., 1946.

It has been shown by C. B. Nickels that sprays against *Acrobasis caryae*, Grote, on pecan are best applied during a period of about a week, beginning when 25 per cent. of the first-generation eggs present have hatched, and that this period can be determined in different localities by collecting and observing the time of hatching of eggs found on pecan nuts. In an effort to develop a simpler method of timing spray applications, investigations were carried out in Texas in 1943 and 1944 on the relation of the time when different varieties of pecan develop receptive stigmas or shed their catkins to the development of the Pyralid.

The results of observations on the progress of emergence of the adults of the overwintered generation and the hatching of their eggs on various dates are given in tables and discussed in relation to the condition of the blossom on pecan trees of several varieties, and it is concluded that there may be sufficient correlation between the time of blossoming stages on certain varieties and the time when eggs of *A. caryae* are deposited and hatch to serve as a basis for determining spraying dates. The time at which 85–100 per cent. of the catkins had dropped from certain protogynous varieties more nearly indicated the spraying date than the time when protandrous varieties developed receptive stigmas. However, the method for determining the beginning of stigma receptivity is simple, and it may be desirable to use it under some conditions. Pending further study, it is suggested that spray applications should be timed to begin 4–8 days after 85 per cent. or more of the catkins are shed from the varieties Mahan, Burkett and Eastern Schley. Observations on the abundance of eggs in the orchard will indicate whether to begin spraying on the fourth or the eighth day. Under conditions in Texas, the sprays should usually be applied during the second week after the shedding of the catkins. Approximately 25 trees in different parts of the orchard should be used to determine this time. Other pecan varieties of the protogynous group may be substituted for those observed in this study, provided that proper adjustments are made for the differences in the time of shedding pollen.

HARING (R. C.). **Azobenzene as an Acaricide and Insecticide.**—*J. econ. Ent.* **39** no. 1 pp. 78–80, 5 refs. Menasha, Wis., 1946.

The author states that in spite of the recorded insecticidal action of members of the azobenzene series [*cf. R.A.E.*, A **25** 35], these compounds were not developed commercially until recently, when new types of dusts were made available, and gives an account of tests with azobenzene dusts. Adults of the colorado potato beetle [*Leptinotarsa decemlineata*, Say], and larvae and adults of the Mexican bean beetle [*Epilachna varivestis*, Muls.] caged with plants that had

received a light coating of 10 per cent. azobenzene in bentonite were all killed in 7, 5 and 3 days, respectively. When twigs supporting colonies of small larvae of *Malacosoma americana*, F., were treated with a dust containing 10 per cent. azobenzene and 1 per cent. of a surface active agent (Nacconol NR) in bentonite, 90 per cent. mortality was obtained in 48 hours. In tests against *Pyrausta nubilalis*, Hb., on maize, two applications of a dust of 20 per cent. azobenzene in whiting at the rate of 30 lb. per acre, seven days apart early in July, resulted in 62 per cent. undamaged ears at harvest, as compared with 42 per cent. for two commercial insecticides.

In a laboratory test, 20 per cent. azobenzene in bentonite, finely ground, gave complete kill of red spider mites [*Tetranychus*] on rose twigs, and the same dust applied to 12-inch carnation plants at approximately 1 lb. per 400 sq. ft. of bench space in the greenhouse gave 98·9 per cent. mortality after four days, mites being killed even inside the folded centre leaves. The dust was evidently a good ovicide, since no small mites were found on the plants during the next three weeks, whereas eggs were hatching on others sprayed with a commercial insecticide. Further applications of 20 per cent. azobenzene in whiting to carnations in ten greenhouses confirmed these results. No foliage injury was observed on carnation, and if a close flower cut was made immediately before dusting, it was possible to dust plants during the blossoming period ; under these conditions a few outer petals were browned on some varieties, but buds fully covered by sepals were not injured. There was an outstanding improvement in the vigour and leaf colouring of plants on which the mites had been destroyed. The percentages of mites killed on leaves from a *Datura* plant that were dusted with 0·5, 1, 2, 5 and 20 per cent. azobenzene in whiting were 80·8, 94·3, 95·4, 100 and 100, respectively. It is recorded that W. E. Blauvelt fumigated rose houses by painting a paste of water and 70 per cent. azobenzene in Celite 209 on the cold steam pipes and turning the heat on to vaporise the azobenzene. A dosage of 1 lb. of the mixture per 40,000 cu. ft. space gave 90–99·75 per cent. kills of all stages of the mite including the eggs.

Azobenzene had little effect on the squash bug [*Anasa tristis*, Deg.], the greenhouse leaf tier [*Phlyctaenia rubigalis*, Gn.] on chrysanthemum and several species of Aphids.

Stevenson (W. A.) & Sheets (L. W.). **Benzene Hexachloride to control Bugs on Cotton.**—*J. econ. Ent.* **39** no. 1 p. 81. Menasha, Wis., 1946.

Since dusts of arsenicals in sulphur have given variable control of the Hemiptera (chiefly Pentatomids and Mirids) that injure cotton in Arizona [*cf. R.A.E.*, A **35** 46], and DDT and sabadilla mixtures, although promising, have not been completely satisfactory, preliminary tests were made with benzene hexachloride. The dusts used in the cage tests were benzene hexachloride ground with talc or deodorised benzene hexachloride ground with gypsum. They contained 10 and 2 per cent., respectively, of the active γ isomer, and were further diluted with pyrophyllite for tests. When the insects were caged with cotton plants, which were then dusted, dusts containing 1, 2 and 10 per cent. γ isomer caused 75, 85 and 100 per cent. mortality of *Chlorochroa sayi*, Stål, 28, 8 and 19–43 hours after treatment, respectively, those containing 2 and 10 per cent. caused 95 and 100 per cent. mortality of *Euschistus impictiventris*, Stål, 8–28 and 19–43 hours after treatment, and one containing 5 per cent. gave complete mortality of *Creontiades femoralis*, Van D., and of species of *Lygus* 15 and 3 hours after treatment, respectively. In another series, in which the 5 per cent. dust was applied to caged cotton plants at varying periods before the introduction of the insects, to test the residual effect, a dust applied 90 hours before killed 90 per cent. of *Lygus* spp. and 20 per cent. of *C. sayi* in 46 hours, a dust applied 24 hours before killed 100 per cent. of *Lygus* in 4 hours and 60 per cent. of *C. sayi* in 46 hours, and a dust applied immediately before killed

80 per cent. of *C. sayi* and 60 per cent. of *E. impictiventris* in 46 hours. Comparison with previous tests [*cf.* **32** 379 ; **35** 46] showed that the mortalities were considerably higher than those usually given by arsenicals in sulphur and rather higher than those given by DDT or sabadilla, and in all tests benzene hexachloride killed the insects more quickly than the sulphur and arsenicals or DDT.

In a field test, unground benzene hexachloride diluted with pyrophyllite to contain 1 per cent. γ isomer was applied soon after daylight on 20th and 27th July and 3rd and 17th August at approximately 20 lb. per acre per application to cotton plants that had a mixed population of injurious Hemiptera of 15 per 100 strokes of the net. Weekly population counts, continued until 5th September, showed an average of 4·1 injurious Hemiptera per 100 strokes after dusting was begun as compared with 7·3 in the untreated plot. The final yields were 2,297 lb. seed cotton per acre for the treated plot and 1,547 for the untreated one. Benzene hexachloride caused no injury to cotton in any of the tests.

Bailey (J. S.) & Bourne (A. I.). **The Control of the Blueberry Bud Mite.**—*J. econ. Ent.* **39** no. 1 p. 89, 4 refs. Menasha, Wis., 1946.

In the spring of 1945, the fruit buds of two varieties of cultivated blueberry in Massachusetts showed signs of attack by *Eriophyes vaccinii*, Keifer [*cf. R.A.E.*, A **29** 259], and microscopic examination revealed the presence of a very heavy infestation. Later in the season it was estimated that the crop was reduced by at least 50 per cent. on infested bushes.

A spray of 4 oz. DN-111 [20 per cent. of a dicyclohexylamine salt of 2,4-dinitro-6-cyclohexylphenol] and 1·6 gm. Ultrawet [an aromatic monosodium sulphonate] in 20 U.S. gals. water, applied at a pressure of 400 lb. on 11th June, reduced the numbers of mites in the buds from an average of 54 per bud to 11 in 5 buds on one variety and from an average of 59 per bud to 12 in 4 buds on the other in 24 hours, but caused severe scorching of the foliage and considerable spotting of the young green fruits. Applications on 20th June of 16 and 20 oz. DN-111 per 100 U.S. gals. with the same adjuvant at a pressure of 150–175 lb. resulted in mite populations of 2·3 and 1 per bud after 48 hours on one variety and 3·3 and 0·5 on the other. Some scorching of foliage and fruit appeared 48 hours after spraying. The concentration of the spray appeared to have little effect on the amount of injury, but the reduction in pressure resulted in much less damage.

Isely (D.) & Miner (F. D.). **Sulfur as an Aphicide.**—*J. econ. Ent.* **39** no. 1 pp. 93–94, 5 refs. Menasha, Wis., 1946.

Inconsistent results have been obtained when sulphur, to control *Aphis gossypii*, Glov., on cotton, has been added to insecticides applied in dusts against other insects, but in various experiments carried out in Arkansas in 1942, 1944 and 1945, sulphur and dust mixtures containing it applied to the undersides of cotton foliage 1–4 times at 15–30 lb. per acre, depending on the size of the plants, reduced the average Aphid population to 5·81 per cent. of that on untreated plots. When three or four applications were made in plot tests, the average infestation was less than 1 per cent. of that on untreated plots, and when only one application was made in a field test it was 48 per cent. It was necessary for enough sulphur to come in contact with the Aphids to be obvious if effective control was to be obtained. The action of sulphur is relatively slow and may continue for as long as seven days after application.

Applications to the lower surface of the leaves of peas in garden plots made in late May and June 1945, when the mean temperature was about 74°F., reduced the population of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) to

32·3 per cent. of that before dusting, whereas on untreated leaves it increased by 23·4 per cent. Only Aphids that were actually touched by the sulphur were killed.

In field experiments against *Rhopalosiphum pseudobrassicae*, Davis, on mustard in November 1945, when the daily mean temperature for the four days after dusting was not more than 60°F., sulphur dust gave relatively poor control, partly because of the difficulty of reaching all the leaf surface on which the Aphids were feeding and partly owing to the low temperature. In the greenhouse, a single application to turnips of a variety with relatively smooth upright leaves that were readily covered with dust, when the mean temperature was about 72°F., reduced the population of *R. pseudobrassicae* to 54·15 per cent. of that before dusting, whereas the population on untreated plants increased by 115·51 per cent.

It is concluded that sulphur is effective as a contact insecticide against several species of Aphids, and that its effectiveness seems to depend on contact with the Aphids at a temperature of about 70°F. or more [*cf. R.A.E.*, A **32** 133]. It is relatively slow in action. If used as a diluent, it may add to the efficiency of other insecticides and in some instances may lengthen the period of effectiveness.

Delgado de Garay (A.). **Cooperación entre los Estados Unidos de Norteamérica y la República de México, para el control del gusano rosado del algodonero.** [Co-operation between the United States of America and the Republic of Mexico for the Control of the Pink Cotton Bollworm.]—*J. econ. Ent.* **39** no. 1 pp. 95–98. Menasha, Wis., 1946.

Since about the year 1920, officials from the United States have co-operated with the Mexican authorities in efforts to control the pink bollworm [*Platyedra gossypiella*, Saund.] on cotton in Mexico. Co-operation was placed on an organised basis by government agreement in 1943, when permanent staffs were appointed by the authorities of both countries to supervise the work in each of the seven regions into which the cotton-growing areas of Mexico were divided. The measures adopted include the sterilisation of cottonseed, the burning of ginning waste and old stalks, field sanitation, and the prevention of ratoon cultivation. As a result of the work, the bollworm has been eradicated from a considerable area in the State of Nuevo León and a rather smaller one in Coahuila.

Dustan (G. G.), Armstrong (T.) & Putman (W. L.). **Preliminary Experiments with Benzene Hexachloride (666) as an Insecticide.**—*Sci. Agric.* **26** no. 3 pp. 106–121, 2 refs. Ottawa, 1946.

Brief accounts are given of the chemistry of 666 (benzene hexachloride) [*cf. R.A.E.*, A **33** 256] and of numerous tests with it carried out in the laboratory at Vineland, Ontario, in 1944 and 1945. The materials used included samples of the pure γ isomer [GBH], crude 666 and refined 666, these last containing 10–12 and 30–40 per cent. GBH, respectively. Unless otherwise stated, they were used in the form of a wettable spray powder composed of 10 per cent. 666 (crude, refined or GBH), 3 per cent. Orvus (a wetting agent containing 32 per cent. sodium lauryl sulphate, the concentration of which in the dilute spray was usually adjusted to 0·5 lb. per 100 gals.) and 87 per cent. pyrophyllite, ground together for 17 hours in a ball mill, and a similar mixture containing DDT was used for comparison. All quantities given for insecticides are per 100 gals. diluted spray. All sprays were mechanically agitated and applied with a De Vilbiss paint sprayer.

In the first test, apples of which the calyx and stem ends were waxed were sprayed individually for 12 seconds and allowed to dry, after which 10 eggs of *Cydia* (*Carpocapsa*) *pomonella*, L., due to hatch within 24 hours were attached to each and incubated at 77°F. and 75–85 per cent. relative humidity. The percentages of efficiency of the treatments, calculated from the numbers of entries in treated and untreated fruits, were 60·1 and 80 for 0·25 and 0·5 lb. relatively pure DDT (96–99 per cent. para-para isomer) and 73·6 and 93·3 for 0·25 and 0·5 lb. pure GBH. Sprays of 2·5 and 5 lb. crude 666 ground with sulphite lye and pyrophyllite (10 : 3 : 87) and of 5 lb. crude 666 in gypsum (20 : 80) were 58·4, 82·2 and 87·9 per cent. effective, respectively, but these results, which were poorer than the GBH content of the sprays would warrant, may have been due to the large proportion of inert matter in them.

In experiments against *Plutella maculipennis*, Curt., larvae in the last two instars were either sprayed for 10 seconds and at once transferred to untreated cabbage leaf, as a test for direct contact toxicity, or were placed on pieces of sprayed cabbage foliage after the spray had dried, primarily as a stomach-poison test. In the first test, 4 lb. crude 666 gave 56 per cent. mortality and was about as effective as 0·25 lb. DDT, but a subsequent test showed that 666 prepared as the wettable spray powder had less contact action than in other formulations. Thus, when all materials were diluted to give a concentration of 0·5 lb. crude 666, the percentage mortalities were 3·3 for the wettable powder, 33·3 for an emulsion of 10 gm. crude 666, 10 cc. Triton X-100 and enough Velsicol AR-60 (largely a mixture of methylnaphthalenes) to make 100 cc., 20 for a precipitated suspension prepared by diluting a similar stock in which acetone replaced the Velsicol, and 26·6 for a solution of 17 per cent. crude 666 in a miscible oil. Used as stomach poisons, 0·125 lb. pure GBH, 1 lb. crude 666 and 0·062 lb. DDT gave approximately equal mortalities (61·6, 53·6 and 53·3 per cent., respectively) as also did double these amounts (71·1, 70·5 and 76·6 per cent.). Similar results were obtained with larvae of *Phlyctaenia rubigalis*, Gn., but when 35 adults were placed in an unsprayed wire screen cage with a plant sprayed with 1 lb. DDT or pure GBH, they survived for averages of 3·8 and 1·1 days, respectively, and laid 388 and 73 eggs. When both plant and cage were sprayed, they survived for averages of 1·4 and 1 day and laid 5 and 40 eggs. Control moths lived more than 8 days and laid over 800 eggs.

Ancylis comptana, Froel. (*fragariae*, Walsh & Ril.) was more resistant to both insecticides. When potted strawberry plants were sprayed and allowed to dry, and 14–20 nearly mature larvae, taken in the field, were placed on each, the percentage mortalities were, respectively, 80, 88·7 and 90 for 1, 2 and 3 lb. DDT, 22·5 and 40 for 1 and 2 lb. crude 666, 53·3 and 81·6 for 1 and 2 lb. refined 666 and 61·6, 85 and 85 for 2, 4 and 6 lb. of a partially refined 666 containing about 22 per cent. GBH, referred to as American 666 and used in the form of a wettable powder containing 50 per cent. other ingredients, as compared with 13·7 in the control. In another test in which treated plants were re-infested a week after spraying, the percentage mortalities were 86·6, 83·3 and 86·6 for 1, 2 and 3 lb. DDT, as compared with 76·6, 88·3 and 90 within 4 days for larvae placed on the plants as soon as the deposits had dried, and 50, 73·4 and 86·6 for 2, 4 and 6 lb. American 666, as compared with 61, 85 and 85.

The percentage mortalities of untreated adults of *Crioceris asparagi*, L., placed in wire screen cages with sprayed asparagus foliage were 100 for 0·5 lb. DDT, 24 for 0·5 lb. crude 666 and 28 for 0·66 lb. refined 666, but in a similar test against *C. duodecimpunctata*, L., they were 28 for 0·5 lb. DDT and 52 for 0·66 lb. refined 666.

Complete mortality of adults of *Diabrotica melanocephala*, F. (*vittata*, F.) on sprayed plants was given by 0·125 lb. DDT or 0·5 lb. refined 666, and 94·5 per cent. by 0·5 lb. crude 666 ; DDT afforded better protection of the foliage. Crude 666 and DDT seemed equally effective against adults of *Macrodactylus*

subspinosus, F. Tested as direct contact sprays against *Rhopalosiphum rufomaculatum*, Wils., on chrysanthemum, 0·25 lb. DDT, crude 666 and pure GBH gave 75·2, 61·1 and 99·6 per cent. mortality, respectively, after 4 days and 1 lb. crude 666 also gave 99·6 per cent., but in a test for residual effect, in which the plants were sprayed before infestation, the numbers of Aphids that resulted after 9 days from initial populations of 30 adults were 123, 40 and 4 for 0·25, 0·5 and 1 lb. crude 666 and 9, 4 and 0 for the same amounts of DDT, as compared with 216 in the control. Adults of *Anasa tristis*, Deg., and pieces of gourd or squash about 3 inches in diameter were dusted with DDT and 666 as the wettable powders, with additional pyrophyllite when necessary, and removed to small clean cages. After 2 and (in brackets) 5 days, mortalities of 100, 100 and 91·6 (100) per cent. were given by 10, 5 and 2·5 per cent. refined 666, as compared with 50 (100), 25 (83·3) and 8·3 (91·6) per cent. for DDT at the same concentrations and 0 (0) in the controls.

Adult females of *Cydia pomonella* confined in cloth-topped battery jars with apple twigs that had been sprayed on the same day with 1 lb. refined 666 in pyrophyllite (1 : 4) without wetter died in an average of 3·5 days, having laid no eggs. Those confined with twigs sprayed two days previously lived for an average of 11·7 days and laid 55·8 eggs, compared with averages of 14·3 and 57·5 eggs in control jars. In a similar test with *Cydia* (*Grapholitha*) *molesta*, Busck, moths confined in jars, whether in direct contact with sprayed twigs or separated from them by wire gauze, all died within 24 hours, and moths confined in jars with a gauze-topped can containing dry refined 666 survived for only 4 days, as compared with 8·8 days in the control, whereas moths confined with freshly sprayed twigs in open wire screen cylinders lived as long as the controls. It is concluded that the vapours given off by 666 spray residues for a short time are very toxic to the adults of both species of *Cydia* and that it is doubtful whether sprays of 666 would have any residual effect on them under orchard conditions.

In tests against *Psylla pyricola*, Först., infested shoots or potted plants of pear bearing nymphs in all instars were sprayed and kept unconfined in the insectary. At a spray concentration of 1 lb., crude 666 gave 99·9 per cent. mortality, as compared with only 16·7 per cent. for DDT as the powder suspension, 51·9 per cent. for DDT in a Velsicol emulsion and 43 per cent. for DDT as a suspension precipitated from acetone ; 0·5 and 0·25 lb. crude 666 gave 88·6 and 91·2 per cent. mortality, and there was 4·5 per cent. mortality in the controls. In a series of tests against nymphs, the difference in toxicity between refined and crude 666 was less than that between their contents of GBH ; thus 86·9 per cent. mortality was given by 0·25 lb. of the latter and 0·2 lb. of the former. Neither had any lethal action on the eggs, but a deposit killed nymphs that hatched from them, its effectiveness increasing as the spray was applied nearer to the time of hatching. In a test on fumigant action, complete mortality was obtained in 6 days when 10 gm. dry crude 666 was placed in the bottom of a quart glass jar and adults of *P. pyricola* and a pear twig were placed above it and separated from it by wire gauze, but only 17·4 per cent. when the jar was replaced by a wire gauze cage and none in the cage without 666 ; when the Psyllids were confined on twigs sprayed with 1 lb. crude 666, all died in a day in either jar or cage. Persistence of toxicity was tested by placing pear twigs sprayed with 1 lb. crude 666 up to 6 days previously in cloth-covered glass containers with adults of *P. pyricola*. There were some inconsistent results, but a general trend of decreasing mortality and higher egg deposition was shown as the interval after spraying was increased. A 6-day old deposit gave 91·7 per cent. mortality in 7 days, with an average of 28 eggs laid per adult, as compared with complete kill in 1 day from a fresh deposit, with no eggs laid. Tests were also made against nymphs of this Psyllid using sprays in which 666 was combined with some common fungicides, without apparent loss of toxicity.

When sprayed adults of *Oncopeltus fasciatus*, Dall., were confined with moisture and seeds of milkweed [*Asclepias*] in wire mesh cages placed on racks so that air could enter from all sides, refined 666 gave 70, 90, 100 and 100 per cent. mortality at 0·025, 0·5, 1 and 2 lb., as compared with 3, 11, 30 and 72 per cent. for DDT. Tests were then carried out to assess the fumigant effect of 666 under these circumstances, and it was found that only 5 per cent. mortality of bugs sprayed with 1 lb. refined 666 was obtained in 4 days when the cage was placed in a breeze of about 8 miles per hour from a fan, as compared with 91 per cent. in still air. When 50 unsprayed bugs were placed in a sealed jar with 50 dead sprayed bugs, separated from them by wire gauze, all died within 4 days, but when the jars were replaced by wire screen cages only 6 per cent. died in the same period. In tests in which the cages of sprayed bugs were exposed to wind velocities ranging from 0 to 6·34 miles per hour inside the cage, the speed of kill varied inversely with the wind speed, though the differences in kill after some days were much less than in the other experiments; the percentage mortality after 1 day in one test ranged from 100 in still air to 4 in a breeze of 6·34 miles per hour inside the cage.

It was observed in the course of the experiment that nymphs of *Thrips nigropilosus*, Uzel, on chrysanthemum were all eliminated by DDT at 0·125 lb., as compared with 80 per cent. reduction for crude 666. *Tetranychus telarius*, L., was only partly controlled by 666 on rose and cucumber, and *Paratetranychus pilosus*, C. & F., on potted apple seedlings was apparently unaffected by it.

Timonin (M. I.). **Influence of DDT on Yeast Fermentation.**—*Sci. Agric.* **26** no. 3, pp. 122–129, 3 refs. Ottawa, 1946.

An account is given of investigations in Canada from which it is concluded that the application of DDT sprays to grapes for the control of insect pests has little effect on the yeast fermentation of the resulting juice, as compared with controls sprayed with lead arsenate, though it reduced the intensity of the process during the first five days. No DDT was detected in the fermented juice from sprayed grapes.

Bolton (J. L.) & Peck (O.). **Alfalfa Seed Production in northern Saskatchewan as affected by *Lygus* Bugs, with a Report on their Control by Burning.**—*Sci. Agric.* **26** no. 3 pp. 130–137, 10 refs. Ottawa, 1946.

During 1941–44, investigations were carried out on the effect of *Lygus hesperus*, Knight, and *L. elisus*, Van D., on the production of lucerne seed in the White Fox area of Saskatchewan. No distinction was made between the two Mirids, the bionomics of which are briefly described. Both are native to northern Saskatchewan, and were present sparsely on wild plants at all sampling points; the only plant other than lucerne on which they were at all numerous was *Chenopodium album*. They appeared to have only one complete generation a year [*cf. R.A.E.*, A **34** 204].

Sweeps taken in lucerne fields between full bloom and the maturing of the pods gave averages of 9·23, 0·45, 6·17 and 13·52 *Lygus* per sweep, in the four years respectively. The reason for the light infestation in 1942 is not known. In 1943, the average number per sweep was 3·6 for first-crop stands, as compared with 8·5 for stands producing their second, third or fourth crops, and infestation was lowest in first-crop stands grown with a nurse crop. In 1944, 19 fields were sampled for brown and shrivelled seed [*cf.* **24** 542] by picking ripe pods at random and threshing them carefully by hand. Since frost discolours lucerne seed, all collections were made before the early frosts occurred. The proportion of the brown and shrivelled seed from the different fields ranged from 9 to 51 per cent. and averaged 22 per cent., the numbers of *Lygus* per sweep ranged from 2 to 50 and averaged 15, and there was a significant positive correlation

between these two sets of values for the different fields. The brown and shrivelled portion was then subdivided by means of an air blast into a heavy and a light fraction, and tests of viability showed germination of 93 per cent. of normal seeds and 26 and 3 per cent. of the heavy and light shrivelled seeds. The heavy and light fractions represented 7 and 15 per cent. of the whole sample.

In northern Saskatchewan it is not practicable to avoid *Lygus* damage by any cultural method that delays the maturing of the crop, owing to the danger from frost, but many growers burn their fields about the second half of April, when little new growth has appeared above ground, with a view to improving the yield. In investigations in partly burned fields in 1944, the average numbers of *Lygus* per sweep, in July, from burned and (in brackets) unburned portions of fields in which comparable samples were easily obtained were 12·0 (20·3), 5·6 (10·3) and 7·6 (8·5), and the seed yields in pounds per acre were 86 (36), 115 (61) and 127 (74), respectively ; the increases in yield were highly significant in each case. It was thought that the burning destroyed both eggs and adults and, by removing food and shelter, prevented re-infestation for at least several days.

Afzal Husain (M.) & Abdul Wahid Khan. **The Citrus Aleyrodidae (Homoptera) in the Punjab and their Control.**—*Mem. ent. Soc. India* no. 1, 41 pp., 3 pls., 37 refs. New Delhi, 1945.

Of the seven species of Aleurodids that attack *Citrus* in the Punjab, *Dialeurodes elongata*, Dozier, *D. citri*, Ril. & How., and *Aleurolobus citrifolii*, Corbett, are major pests in most parts of the Province, *Aleurocanthus husaini*, Corbett, is a serious pest in the south-east, *A. woglumi*, Ashby, is of importance near Lahore and Shahdara, *Aleurolobus marlatti*, Quaint., is only a minor pest, and *Aleurotuberculatus murrayae*, Singh, is rare. The authors consider that *Aleurocanthus punjabensis*, Corbett, which was described from a single specimen from their material [*R.A.E.*, A **23** 103] is a synonym of *A. woglumi*, and that records of *A. spiniferus*, Quaint., on *Citrus* at Pusa [**9** 71] and in the Punjab [**13** 222] also refer to *A. woglumi* ; they have not found *A. citriperdus*, Quaint. & Bak., in any part of the Punjab, though it was recorded from Lahore in 1911. Aleurodids are present in almost all the *Citrus* orchards of the Punjab, and many extensive orchards have ceased to bear fruit as a result of infestation. Heavily attacked trees become covered with sooty mould, which grows on the honeydew secreted by the insects, and produce little blossom, most of which is shed, and insipid fruit. Infested trees do not usually become stunted, and the leaves show no external injury, but the infestation apparently upsets the nutritive balance of the plant and interferes with its reproductive activity.

Descriptions are given of the pupal case of *Aleurotuberculatus murrayae* and of the eggs, three larval instars, pupae and adults of both sexes of the other species, together with notes on their distribution and food-plants and a list of the Aleurodids that have been recorded from *Citrus* throughout the world, showing their distribution and relative importance.

D. citri was found in all the *Citrus*-growing areas of the Punjab and causes very serious injury in several localities. It appears to have no alternative food-plants in this Province [*cf.* **20** 652]. The eggs are deposited singly over the lower surface of the young leaves ; the largest number laid by one female in the laboratory was 201, in an oviposition period of four days. There are two generations a year. Adults of the overwintered generation usually emerged and oviposited in March–April and those of the summer generation in August–November. The newly hatched larvae usually moved about on the leaves for some 24 hours and then attached themselves on the lower surface. The egg, larval and pupal stages lasted 10–12, 25–51 and 125–154 days for the summer generation and 7–14, 49–71 and 114–159 days for the winter one ; adults

survived for 2–8 days in sleeves on their food-plants. All stages were present during March and April and from August to October, but only pupae in June and July and, usually, from October to the end of February. Severe frost caused no mortality of overwintering pupae, but delayed emergence by a fortnight, and great summer heat resulted in earlier emergence of adults of the summer generation. The adults do not move far during the day, but fly from plant to plant at dusk ; they always congregate on crowded and bushy trees.

D. elongata occurs in several parts of the Punjab and does considerable damage to orange in the Lyallpur district. It has been collected from all species and varieties of *Citrus*, but from no other plant in the Punjab, although *Ixora coccinea*, *I. parviflora* and litchee (*Litchi chinensis*) have been recorded as alternative food-plants in Bihar. There are two generations in the year, concurrent with those of *D. citri*. The eggs are deposited singly on the lower surface of the young leaves ; they hatched in 6–9 days in April and in 12–14 days in October and November. The young larvae fixed themselves along the veins of the leaves after moving about for some time. The larval and pupal stages lasted 24–40 and 109–120 days for the summer generation and 36–42 and 102–114 days for the winter one.

Aleurolobus citrifolii is a serious pest of *Citrus* in some localities and has also been found on *Murraya exotica*. The eggs are deposited singly on the lower leaf surface and hatched in 10–12 days in April, 7–9 days in August and 13–14 days in October. The larvae moved over the leaf for about a day and then fixed themselves on either the upper or the lower surface. The larval stage varied from 33 to 61 days and the pupal stage from 39 to 104 days, according to the season. Both larvae and pupae secrete copious honey-dew. The generations overlap, all stages being present from March to December, but only pupae from December to the end of February.

Aleurocanthus husaini and *A. woglumi* have both been found only on *Citrus* in the Punjab and have two generations a year ; the adults emerge and oviposit in March and April and from July to October or November. The eggs of *A. husaini* are usually laid in spirals on the lower surface of the leaves ; each spiral consisted of one whorl and contained 9–17 eggs. The larvae hatched in 9–12 days in April, 7–9 in August and 8–12 in October, and moved little before settling. The larval and pupal stages lasted 26–52 and 64–108 days, according to temperature. The eggs of *A. woglumi* are laid in spirals of three whorls containing 15–22 eggs. The females lay 1–3 spirals each, and large numbers occur on a single leaf. The eggs hatched in 7–14 days in April, 7–9 in August and 12–14 in October, and the larvae did not move far before settling. The larval stage lasted 45–60 days in May–June, 38–43 days in August–October and 48–60 days in October–December, and the pupal stage 99–131 days except in winter, when it lasted 147–161 days.

Aleurolobus marlatti attacks all cultivated varieties of *Citrus* and also *Murraya exotica*, but although it is widely distributed in the Punjab, it does no appreciable damage. The generations overlap, and all stages are present from March to December, but only pupae in January and February. Eggs are deposited singly on either side of the leaves and hatch in 5–14 days. The larval stage lasted 12–35 days and the pupal stage 36–77 days. Adult emergence begins early in March.

The only parasites bred from these Aleurodids were *Eretmocerus* sp. from larvae and pupae of *Aleurocanthus husaini* and *Prospaltella* sp. from larvae of *D. citri*, from which *P. lahorensis*, How., has previously been recorded in the Punjab [**1** 278]. Predators included the Coccinellids, *Brumus* sp., *B. suturalis*, F., and *Scymnus* sp. feeding gregariously on eggs and larvae of various Aleurodids, and larvae of a species of *Chrysopa*, feeding on the larvae. A list is given of parasites of *Citrus* Aleurodids found in other parts of the world.

Various sprays were tested against *D. citri*. The only ones that gave almost complete control of the eggs, larvae and pupae contained one or other of two forms of saponified resin, the preparation of which is described. Protective measures comprise planting the trees 20–25 ft. apart and where they are not shaded by other trees, and eliminating *Citrus* hedges round the orchards unless they are used as a trap crop and pruned regularly.

CAMERON (A. E.). **Insect Pests of 1944.**—*Trans. Highl. agric. Soc. Scot.* (5) **57** pp. 54–72, 6 figs., 5 refs. Edinburgh, 1945. **Insect and other Pests of 1945.**—*Op. cit.* (5) **58** pp. 100–120, 10 figs., 6 refs. 1946.

These notes on the occurrence of injurious insects and their control in Scotland in 1944 and 1945 include an account of a local outbreak of *Macrosiphum dirhodum*, Wlk., on timothy grass [*Phleum pratense*] in the spring of 1944 in central Scotland, where this grass is widely grown for forage and seed. Infestation was practically confined to parts of the crop that had been grown for seed in the previous year, on which few leaves were uninfested in April and May. The foliage wilted over areas ranging from 2 to 4 acres in extent. The outbreak collapsed during June owing to parasitism by *Aphidius* sp. and was not repeated in 1945.

Myzus persicae, Sulz., was found in 1944 infesting a large plantation of strawberries in the Lothians, where it has lately been injurious to various crops [*cf. R.A.E.*, A **35** 4]. The infestation had begun in the summer of 1943 and the Aphids had overwintered on the plants. The attack was renewed in April 1944, and the plants in infested patches were stunted and unhealthy by May. The Aphid was mainly confined to the young flowers and the partly opened leaves, and caused a decrease in yield. Symptoms resembling those of leaf crinkle [*Marmor fragariae* of Holmes] appeared later, but it was uncertain whether they were due to a virus or to the intense infestation. Migrants developed in July and left the plants, on which no Aphids except a small population of *Capitophorus fragariae*, Theo., remained. The plants then recovered and lost all external signs of leaf crinkle. A nicotine dust had been applied in June, but had not proved satisfactory, owing to the protected position of the Aphids.

Damage to wheat by *Agromyza* (*Domomyza*) *ambigua*, Fall., was recorded in 1944, apparently for the first time in Scotland, and oats, barley, couch grass [*Agropyrum repens*], Yorkshire fog [*Holcus lanatus*] and tall oat-grass [*Arrhenatherum avenaceum*] were also infested. This Agromyzid appears to have two generations a year in Scotland, the pupae overwintering in the soil. The larvae construct mines extending across the whole width of the leaf and for 6–8 ins. downwards from the tip, and heavily infested plants die. Injury was serious in Berwickshire and the Lothians. Other pests that had increased by 1944, possibly owing to increased cultivation of their food-plants, were *Oscinella frit*, L., on oats, *Hylemyia* (*Leptohylemyia*) *coarctata*, Fall., on winter wheat, barley and oats, and *Pegomyia hyoscyami* var. *betae*, Curt., on mangels and sugar-beet. *Pegomyia* had been favoured not only by the increased cultivation of beet but also by the substitution of mangels for swedes in districts where the swede midge [*Contarinia nasturtii*, Kieff.] is injurious. Adults appear in May and June, and begin to oviposit when the plants have developed 4–6 leaves. The larvae hatch in 5–6 days and complete their development in 10–12 days. Most pupate in the soil near the surface, but a few do so in the mines near the margins of the leaves. Three generations are produced each year at intervals of 6–8 weeks. Both beet and mangels may recover almost completely, provided that the weather favours rapid growth and the central shoots are not damaged.

Injury by *Tipula paludosa*, Mg., and other Tipulids to ley pastures, cereal crops, bowling greens and city lawns was reported in 1944. It first became apparent on winter wheat at the end of March and on ley oats at the end of April and the beginning of May, and, where the use of bran baits poisoned with

Paris green had been neglected or delayed, necessitated the resowing of whole fields of wheat, oats and barley. In parts of West Lothian, the numbers of larvae in lowland pastures that had been stripped almost bare were estimated at 2¾ million per acre in June, and the larvae were equally numerous and injurious in upland pastures. Infestation continued to be heavy in 1945, when beans were severely damaged in two localities in the Lothians in May ; it has been favoured by a succession of wet autumns, but that of 1945 was dry, so that little injury was anticipated for 1946.

In early July, 1945, the ripening fruits of tomato in a glasshouse near Edinburgh were extensively damaged by larvae of *Peridroma* (*Agrotis*) *saucia*, Hb., which fed chiefly by night and sheltered in the trusses or among the foliage by day. By 12th July, they had entered the moss litter mulch, in which they pupated. The adults emerged in late August and early September, and gave rise to another generation, of which the larvae attacked glasshouse chrysanthemums in October and November. The occasional abundance of this Noctuid in Scotland is probably associated with large-scale immigrations from the continent. Damage to the flower buds and blossoms of glasshouse chrysanthemums by *Phlogophora meticulosa*, L., during the autumn and early winter was general and severe in the Lothians and Border counties.

An outbreak of *Orgyia antiqua*, L., occurred during July–September 1945 on young larch and Scots pine [*Pinus sylvestris*] in a small upland plantation in Perthshire. The larch and the associated heath vegetation were completely defoliated, but the pine was less severely injured, as only the needles of the previous year were attacked.

Hey (G. L.). **Experiments with new Insecticide promise speedy Death to Red Spider in Glasshouses. Results in 1946.**—*Grower* **26** no. 14 pp. 298–299, 1 fig. London, 1946.

The results are given of investigations on the effectiveness of sprays of crude azobenzene, carried out in England in 1946. The sprays used were prepared from a paste containing 50 per cent. of the compound, unless otherwise indicated; other forms tested comprised a fly-spray containing 5 per cent. in kerosene, which was found to stain, a wettable powder containing 20 per cent., which was difficult to make and left a visible deposit, and a stock emulsion containing 10 per cent. azobenzene and 60 per cent. white oil, which was injurious to the plants. A spray containing 0·1 per cent. azobenzene with a commercial wetting agent (Coverite) gave complete kill of all active stages of *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) on apple trees and reduced the percentage of summer eggs that hatched during the next nine days from 50 to 25, but lower concentrations were much less effective. The spray caused almost complete defoliation seven days after application on two varieties, slight scorching and brittleness of leaves on two others and no apparent damage to a fifth. The same spray gave complete control of active stages of *Tetranychus telarius*, L., in 48 hours and good control of the eggs on tomato, cucumber and climbing bean, with no damage to the plants, but the kill of eggs was reduced when the concentration of azobenzene was halved. The spray also gave almost 90 per cent. mortality of this mite on grape vine and almost 100 per cent. on rose and *Hydrangea*, with good egg control and no damage to the plants. A similar spray containing 0·4 per cent. azobenzene with Coverite gave complete kill of active stages of *T. telarius* on heavily infested carnations within 24 hours and good control of the eggs ; no living mites were observed 14 days after treatment. When the concentration of azobenzene was reduced to 0·2 per cent. complete control of the active stages was obtained in 48 hours and egg mortality was reduced, and at 0·1 per cent. it did not give complete kill in 72 hours and control of the eggs was poor. In no case did the spray damage the plants, and the new foliage developed clean and unmarked.

The deposit from the 0·1 per cent. spray applied to filter paper and allowed to dry caused complete mortality in five and three days, respectively, of larvae of *Vanessa atalanta*, L., and *Aglais* (*V.*) *urticae*, L., that were left in contact with it for 16 hours, whereas larvae that were kept for the same period on untreated filter paper survived and fed normally; concentrations of 0·5 and 0·025 per cent. permitted 30 and 100 per cent. survival, respectively, of *V. atalanta* after five days. A spray made from the wettable powder and containing 0·1 per cent. azobenzene gave complete kill within 24 hours of larvae of both species when these were put on sprayed nettle leaves. Neither the oil emulsion (0·05 per cent. azobenzene) nor a wettable-powder spray (0·1 per cent. azobenzene) gave any control of *Aphis fabae*, Scop. (*rumicis*, auct.) on broad beans, and the latter with the addition of Coverite gave none of the mealy plum Aphid, *Hyalopterus arundinis*, F. A 0·5 per cent. spray had no effect on large or small larvae of *Cossus cossus*, L., whether applied to the substratum, the food or the larvae themselves. Wasps were killed within five minutes when sprayed with 0·1 per cent. azobenzene as the wettable powder and within two minutes when sprayed with 5 per cent. azobenzene in kerosene.

MACKERRAS (I. M.) & WEST (R. F. K.). **" DDT " Poisoning in Man.**—*Med. J. Aust.* March 23rd 1946 p. 400 repr. 4 pp., 1 ref. Sydney, 1946.

Accounts are given of four cases of DDT poisoning observed in New Guinea. The first two were the most severely affected of some 25 men who ate a tart in which DDT had been used in mistake for baking powder. All the men were affected to some extent and all recovered within 48 hours. The third case was a man who had been applying a solution of DDT in oil from a dropper bottle against mosquito larvae and who had been using a bottle that lacked a protective collar round the neck, probably for several weeks, so that his right hand had become covered with DDT solution on six days of the week. He developed swelling, numbness and weakness of the right hand and arm and suffered from headaches and vomiting, and his temperature rose to 101°F. Most symptoms disappeared four days after he stopped duty and muscular power became normal in a fortnight. The fourth man got DDT powder in his eyes and became blind for a fortnight. Recovery was complete. The early signs of DDT poisoning are summarised; any men who show numbness, weakness and headache should be immediately relieved of any duties that involve the handling of DDT until they have completely recovered.

WALLACE (C. R.). **The Black Beetle Pest as it affects coastal Dairy Farmers.**—*Agric. Gaz. N.S.W.* **57** pt. 3 pp. 121–124, 144, 2 figs. Sydney, 1946.

Adults of the Dynastid, *Heteronychus sanctae-helenae*, Blanch., which attack plants of many kinds in the coastal districts of New South Wales [*cf. R.A.E.*, A **34** 382] are very injurious on dairy farms, where they destroy fodder crops and damage pasture. Their attacks on these farms are confined almost entirely to graminaceous plants and they prefer maize and *Paspalum dilatatum*, which are the plants most frequently grown as forage for dairy cattle. Young maize plants up to 6 ins. high are the most susceptible; those that attain a height of about 1 ft. usually withstand moderate attack, but even mature plants are liable to be cut below ground level and destroyed if infestation is severe. The beetles feed heavily upon the horizontal stems of *Paspalum*, which may be completely eliminated from pastures when the effect of serious infestation is aggravated by drought and overstocking. The types of sugar-cane known on the North Coast as " cow cane " are also liable to attack. Young sorghum plants seem to be unpalatable to the beetles, but older plants are sometimes attacked and all fallen stalks should be gathered up promptly. Wheat, oats and young rye-grass [*Lolium*] can usually be grown with safety, especially if sowing

is delayed as far into the autumn as climate permits. Old established rye-grass appears less susceptible than most other grasses, while *Phalaris tuberosa*, kikuyu grass [*Pennisetum clandestinum*] and Japanese millet [*Echinochloa frumentacea*] can withstand very heavy infestation. Pumpkins are not attacked except in mass infestations, when the fruits are damaged by beetles boring into the rind where it is in contact with the soil. Leguminous plants are avoided.

Damage to fodder crops and pastures can be prevented or reduced by the substitution of resistant grasses for *Paspalum*, the incorporation of clovers or lucerne in grass pastures, the use of sorghum or Japanese millet on infested land on which it is desired to raise a fodder crop, and the sowing of cowpeas with maize or sorghum and of field peas or vetches with winter cereals to provide a reserve of fodder if the cereals are destroyed. If infestation is heavy at the end of winter, the sowing of susceptible crops should be delayed until most of the overwintered beetles have died out, usually between mid-November and late December, but not much beyond this or the young plants will be attacked by newly emerged beetles. There is much evidence to suggest that bare fallowing of the land between August and mid-March would reduce infestation.

Insect Pests.—*Agric. Gaz. N.S.W.* **57** pt. 3 pp. 137–140, 6 figs. Sydney, 1946.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **35** 6] includes notes on the bionomics and control of the mole-crickets, *Gryllotalpa africana*, P. de B., and *G. australis*, Erichson [*cf.* **29** 237], which were very injurious in seed-beds in 1945–46. The liquids recommended for injection into their tunnels to force them to the surface of soil or turf [*loc. cit.*] include a mixture of 1 oz. pure derris powder and 3 oz. soft soap in 3 gals. water and an emulsion of eucalyptus oil and soft soap ; a kerosene emulsion can also be used in this way, but may scorch grass roots. Heavily infested areas can be flooded with one of these mixtures or with nicotine sulphate and soap solution. Top dressings of 5 lb. lead arsenate in 1 bushel of screened moist sand or good top soil per 1,000 sq. ft. of turf, applied against Lamellicorn larvae, have been found effective against the crickets in lawns ; the dressing should be applied when the grass is dry, and repeated in three successive years to build up a layer of poisoned soil.

Birch (L. C.). **The Movements of *Calandra oryzae* L. (small Strain) in experimental Bulks of Wheat.**—*J. Aust. Inst. agric. Sci.* **12** no. 1–2 pp. 21–26, 1 fig., 4 refs. Sydney, 1946.

Infestation by insects of wheat stored in bulk in Australia during recent years was in general confined to the upper few inches of the grain [*cf. R.A.E.*, A **34** 121], and since the reason for this was not known, investigations were carried out on the movements of *Calandra oryzae*, L., in wheat and its ability to breed at a depth of 4–5 ft. Precautions were taken to prevent the accumulation of carbon dioxide, though it was not thought that this had been responsible for preventing multiplication in the deeper layers. Well-ventilated, covered experimental bins 1 ft. square and 5 ft. deep, holding 4 bushels of wheat, were infested with adults of the small strain [**34** 21] while they were being filled with wheat containing 12–13 per cent. moisture, so as to introduce 6,000 insects (one per 500 grains) evenly throughout the bin, or in the top or the bottom six inches, or 60,000 evenly throughout the bin. They were kept in a room in which the temperature was 28°C. [82·4°F.], the temperature of the wheat at depths of 1, 2, 3 and 4 ft. was measured daily, and the distribution of insects was studied by withdrawing samples ten days after the beginning of the experiment and then at various intervals for three or more months.

The following is based on the author's discussion of the results. It was found that the insects moved very little from the point at which they were introduced, whether this was at the top, the bottom or throughout the wheat, until the

temperature had risen above 32°C. [89·6°F.]. A rise in temperature, beginning within 2–3 weeks at the points of initial infestation, was observed in every test, and the temperature throughout the wheat eventually rose to 34–38°C. [93·2–100·4°F.], regardless of the position of the initial infestation. In all cases, living insects were finally confined mainly to the top few inches, where the wheat is coolest owing to loss of heat to the air. Bins in which the initial infestation was on the bottom took longest to heat, and insect reproduction was slowest in these.

Under the conditions of these experiments, it is evident that *C. oryzae* can live and reproduce at a depth of 5 ft. in wheat until the temperature becomes too high for breeding. The heating of the wheat was due to the metabolism of the insects introduced.

Birch (L. C.). **The Heating of Wheat stored in Bulk in Australia.**—*J. Aust. Inst. agric. Sci.* **12** no. 1–2 pp. 27–31, 2 graphs, 11 refs. Sydney, 1946.

During the war, when large quantities of wheat were stored for unusually long periods, a marked rise in temperature was observed in many bins and bulkheads in which the grain was stored loose. This occurred throughout the mass of wheat in many cases. In one instance in Western Australia, a 20,000-bushel bulkhead of wheat of about 12 per cent. moisture content became heated throughout its total depth of 16 ft. The mean air temperature was 23°C. [73·4°F.] when the bulkhead was filled and averaged 18°C. [64·4°F.] during the next eight months. After these eight months the temperature of the wheat was 31–38°C. [87·8–100·4°F.]; after a year it was above 40°C. [104°F.] which is above the maximum at which either *Calandra oryzae*, L., or *Rhizopertha dominica*, F., can multiply [*cf. R.A.E.*, A **34** 189], throughout most of the stack; and after two years the temperature at some parts on the floor of the bulk was as high as 51°C. [123·8°F.]. The coolest wheat was on the surface, where the loss of heat was greatest, and this was about the only part in which temperatures were low enough for these insects to breed. Examination of the wheat throughout its depth at this time showed that severe insect damage was confined to a depth of 4–5 inches over the surface and of several inches on the floor, and that most of the wheat was undamaged, though some was spoilt by high temperatures.

Formulae are given for the calculation of the rate of heat production throughout the bulk that is necessary to produce the changes in temperature observed and the temperatures at different depths at any particular time before the equilibrium temperature is reached, and it is shown that the rate of heat production in the bulkhead under consideration must have been 0·12 British thermal units per cu. ft. per hour. This could not be caused by the respiration of wheat containing 12 per cent. moisture or by microflora, but calculations based on the known respiration rates of *C. oryzae* and *R. dominica* showed that if the population of the former consisted of equal numbers of half-grown larvae, mature larvae and adults, one insect in 1,000 grains at 23°C. or one in 1,600 grains at 32°C. [89·6°F.] would be enough to cause it. This disregards the changes in population and temperature that would occur in the wheat, and allowing for a sixtyfold increase in insect density in two months, such as occurs in both species in wheat at a temperature of 23°C. and 12 per cent. moisture content, an initial population of one insect in 300,000 grains would be sufficient to give the increase in temperature of 17°C. [30·6°F.] observed in the centre of the bulk after eight months. Even this is an underestimate, as an increase in insect density results in a rise of temperature and a consequent increase in the rate of metabolism of the insects; the rate of heat production of larvae of *C. oryzae*, for example, is twice as high at 33°C. [91·4°F.] as at 23°C. The maximum temperature at which *C. oryzae* can multiply is 33°C., whereas *R. dominica* can multiply at 38°C., depending on the moisture content of the wheat. At 23°C.,

the rate of reproduction of both species in wheat containing 11 per cent. moisture is about a third of that in wheat containing 12 per cent., so that the initial density required to produce the same increase in temperature would be three times as great. The rate of respiration of the insects is not affected by the moisture content of the wheat to any appreciable extent. The rise in temperature at different times resulting in bulkheads of various depths from infestations of mixed stages of *C. oryzae* at an average density of one insect in 2,000 grains is calculated.

It is pointed out that the numbers of insects required to cause this heating are so small that the wheat would probably be classed as free from insects by most observers, and that it is possible for wheat to heat to the lethal point with only a negligible proportion of the grains showing damage. The grain would then become free from living insects and be unlikely to become reinfested. The only parts of the bin in which the temperature would be sufficiently low for the insects to survive would be on the surfaces and sides, and recent experience has shown that insect damage is generally confined to a few inches near the surface [*cf.* preceding abstract].

In view of these results it is suggested that bulk wheat might be completely protected from insect damage by adequate insulation of the surface, and that several inches of sawdust (preferably separated from the wheat by canvas to prevent the two from mixing during the emptying of the bulkhead) would probably be sufficient ; wheat could be used for this purpose, but would have the disadvantage of becoming infested. The results also indicate that infested wheat would be more safely shipped abroad in bulk than in bags.

NORRIS (D.). **Failure with " D.D.T. " and Success with " Gammexane " in the Control of the Culture Mite.**—*J. Aust. Inst. agric. Sci.* **12** no. 1–2 pp. 51–52. Sydney, 1946.

In attempts to control *Tyrophagus putrescentiae*, Schr., which is injurious to cultures of fungi in the laboratory at Canberra, a saturated solution of DDT in alcohol was added to agar slopes in test-tubes and drained off into the cotton-wool plugs, after which the slopes were dried for several days and then sown with heavily infested cultures. Large populations of mites subsequently developed on 22 of 45 treated and all of 45 untreated slopes. In case this method failed because the fungus grew over the DDT on the agar surface quickly enough to prevent the mites from coming into contact with it, tests were next made with uninfested cultures of fungi, in which the cotton-wool plugs were dipped in DDT solution after sowing. After contact with infested cultures for two months, six of ten treated cultures and all of ten untreated ones were heavily infested.

In tests in which ten slopes treated with DDT and ten with a saturated solution of crude commercial 666 [benzene hexachloride] in alcohol, by the first method, and 20 untreated ones were sown with a newly isolated clean culture of a green species of *Penicillium* and left for three months with old infested cultures, mite infestation developed in 12 of the untreated tubes and four of those treated with DDT, but in none of those treated with 666. It was observed, however, that the fungus would not grow at all on the surfaces treated with 666 and grew only very slowly and atypically after they were broken to expose fresh agar. Subsequent subculture to untreated slopes gave normal colonies. In another test, the plugs of five sterile agar slopes were dipped in DDT solution, those of ten in 666 solution, and 15 were left untreated ; all the tubes were allowed to lie in a heap with cultures of *Acrostalagmus*, which is readily disseminated by mites, and with mite-infested cultures. After two months, 13 untreated slopes and three of those treated with DDT were infested with mites and heavily contaminated with *Acrostalagmus*, but the slopes treated with 666 remained sterile.

The method of dipping plugs in 666 solution has been adopted as the standard practice for some time, and although large numbers of subcultures of fungi and *Rhizobium* spp. have been made and old infested cultures have been kept with them, no trace of mite invasion or of mite-borne contamination has developed. It is customary to dip the plugs after sowing the slopes, but unless the dipping is done very quickly, the plugs absorb so much alcohol that growth of the organism is affected by alcohol vapour, and it would be preferable to dip all plugs as soon as the medium is prepared, so that they have dried before the slopes are used. It is possible that a 666 dust would be equally satisfactory, although this would tend to contaminate plugs instead of sterilizing them.

Common Names of British Insect and other Pests. Part I. Slugs and Snails : Eelworms : Beetles : Flies : Sawflies, Wasps and related Insects.—30 pp., Association of Applied Biologists, 1947. Price 2*s*. (Copies obtainable from Dr. I. Thomas, 47, Tennyson Road, Harpenden, Herts.)

This is the first part of a list of popular names of insects and other pests in Britain that have been approved by the Conference of Advisory Entomologists and the Pests and Diseases Committee of the Association of Applied Biologists. The scientific and popular names of the insects are arranged alphabetically under Orders, the popular names approved for the insects in an American list [*R.A.E.*, A **30** 528] are also given, and foot-notes show cases in which the same popular name is applied to different insects in the two lists.

The Importation of Plants Order of 1947.—*S.R.O.* 1947 no. 671, 7 pp. London, 15th April, 1947.

This Order, which came into force on 1st May 1947, amends and consolidates the regulations affecting the importation of plants, etc., into England and Wales [*R.A.E.*, A **27** 355 ; **28** 297 ; **33** 232]. It retains the prohibition of the import of potatoes from Canada, the United States and France and extends existing restrictions on the landing of living plants and parts thereof for planting (except seeds) and, between 1st April and 15th October in any year, of cider apples and raw vegetables, excluding mushrooms, cucumbers, marrows and pumpkins, from countries in which the Colorado beetle [*Leptinotarsa decemlineata*, Say] occurs to the whole of Europe, the United States of America and Canada, and those on the landing of potatoes to all European countries except France. Another change has the effect of removing the prohibition on the importation of chrysanthemums which was designed to prevent the introduction of *Diarthronomyia chrysanthemi*, Ahlberg (*hypogaea*, auct.) [**27** 356].

Paillot (A.). **Le carpocapse *Laspeyresia pomonella* L. dans les principales régions fruitières de France—Introduction.**—*Ann. Epiphyt. Phytogén.* **5** fasc. 2 pp. 105–107. Paris, 1939.

Régnier (R.). **Le carpocapse en Normandie.**—*T.c.* pp. 109–122, 7 figs., 17 refs.

Balachowsky (A.) & Viennot-Bourgin (G.). **Cinq années de recherches sur le carpocapse (*Laspeyresia pomonella* L.) en France.**—*T.c.* pp. 123–168, 20 figs., 5 graphs, 131 refs.

Vincent (—), Boischot (—) & Herviaux (—). **Le carpocapse dans le Finisterre.**—*T.c.* pp. 169–171.

Sélariès (P.). **Le carpocapse en Alsace.**—*T.c.* pp. 173–175.

Moreau (L.) & Vinet (E.). **Le carpocapse dans la vallée de la Loire.**—*T.c.* pp. 177–181.

Soulié (H.). **Le carpocapse dans la région du Centre de 1936 à 1938.**—*T.c.* pp. 183–197, 8 figs., 4 refs.

Paillot (A.). **Le carpocapse dans la région Lyonnaise et les régions limitrophes.**—*T.c.* pp. 199–211, 5 figs.

Feytaud (J.). **Notes sur le ver des pommes et des poires dans le Sud-Ouest.**—*T.c.* pp. 213–218, 1 ref.

Joessel (P.-H.). **Le carpocapse dans la région d'Avignon de 1933 à 1937.**—*T.c.* pp. 219–248, 8 figs., 63 refs.

Paillot (A.). **Conclusions générales sur la biologie du carpocapse en France et sur les traitements insecticides et fongicides des pommiers et des poiriers.**—*T.c.* pp. 249–256.

These papers contain détailed accounts of investigations on the bionomics of *Cydia* (*Laspeyresia*) *pomonella*, L., the damage it causes and its control in different parts of France, and the last of them is a review of the others. Investigations on the dates of emergence of adults of the overwintering generation were made by means of bait-traps containing dregs of cider with vinegar, or molasses and water, or fermented apple juice that were hung in the trees, or by means of rearing cages. Variation in date of emergence is considered to be due to a number of factors, including temperature, which must be above 16°C. [60·8°F.] during the early hours of the night to be favourable, weather conditions during the period of diapause and the nature of the food-plant, larvae on pear transforming to adults before those on apple and the latter before those on walnut. Generally, emergence began about 20th June in the north-west (attacks in Normandy in the first half of June, formerly attributed to *C. pomonella*, being apparently due to *Hoplocampa testudinea*, Klug) ; in the middle of May or the beginning of June, with maximum emergence during June, in the neighbourhood of Paris ; never before the beginning of June in the Quimper region ; in the middle of May in the regions of Lyons and Avignon ; and at the beginning of May near Bordeaux. In the central region there are great differences between the fruit-growing districts in some years, emergence beginning at the end of May or in the middle of June according to weather. In many places a certain proportion of the first-generation larvae do not overwinter, but transform to adults that give rise to a second generation, which varies in importance with the region and weather conditions. The percentages of larvae that transformed to adults in the same summer were 5 in Alsace, 2–7 in the central plateau, 15–50 at Lyons [*cf. R.A.E.*, A **26** 192], 20 at Avignon and 0·5 in the region of Paris ; in Normandy there was practically no summer emergence.

Females oviposited almost throughout their lives, laying up to 50 eggs each. The first-generation eggs were generally deposited on the leaves, singly or in small groups, and hatched in 20 days at 14°C. [57·2°F.] and in 7–12 days at 20°C. [68°F.] and 75 per cent. relative humidity. The larvae wandered about over the leaves or fruits for 2–5 days before entering the fruits. The pips of apple and pear and the kernels of walnut seemed to be the preferred food, and Soulié observed that if the fruit contains few pips, the larva attacks a second fruit after devouring all the pips in the first. The larvae leave the fruit when full-fed and spin their cocoons, generally in a crevice in the bark of the tree or in a sheltered position nearby, though Régnier found that in well-kept orchards in Normandy more larvae hibernate in neighbouring buildings or packing sheds than in the orchards themselves. Overwintered larvae pupate in April–June, and the pupal stage lasted 20–30 days according to temperature. *C. pomonella* attacks many sorts of fruit in varying degrees. In the Avignon region, where apples are the favoured food-plant, Joessel found that peaches are not attacked except in outbreak years, during a scarcity of pip fruits and in districts in

which pip and stone fruits are planted together. Apricots are infested hardly at all where they are almost the only fruit cultivated, but are often infested where pears predominate. The larvae appear to prefer the ripest fruits, and early varieties are attacked before late ones.

Balachowsky & Viennot-Bourgin consider that the first spray against *C. pomonella* should not be applied until the beginning of June, some time after flowering, but it has repeatedly been found that an application before all the petals have fallen is effective against the first larvae that hatch, as well as against other pests, and the addition of ½–1 lb. lead arsenate per 100 gals. to the Bordeaux mixture (1 : 2 : 100) applied against fungi at this time is therefore recommended. The second treatment should be applied at the time the first larvae are hatching. This would best be determined for each region and year by means of observation posts, but dates for the different districts are suggested on the basis of the information already obtained. The spray should consist of lead arsenate in Bordeaux mixture, preferably with the addition of nicotine sulphate and kerosene or ground-nut oil emulsions, and the same spray without Bordeaux mixture should be applied again about three weeks later. The emulsion also controls larvae of *Epidiaspis leperii*, Sign., and *Psylla pyricola*, Först., on pear. Late treatment against the second generation and the last larvae of the first, which sometimes continue to hatch until August, may be necessary, but substitutes for arsenicals should be used, except on late varieties of which the fruit is harvested at the end of September or the beginning of October [*cf.* **26** 525]. In all spraying, care should be taken to cover the trees adequately by applying the sprays thoroughly at a pressure suitable to the height of the tree.

The supplementary control measures discussed include the use of ordinary or chemically treated bands of corrugated cardboard, and of paper bags for protecting the fruit from young larvae. The bags have been tested in several regions and have shown promise in small orchards of low trees. They are best applied when the fruit is thinned and before the oviposition period begins. In the Loire valley, this treatment was shown to have no ill effects on the maturing of the fruits or their flavour. It is particularly important in the region of Lyons and the Rhône valley, where it is also effective against *Ceratitis capitata*, Wied., which destroys more than 50 per cent. of the crop of autumn and winter pears in some years. Régnier observed in Normandy that infestation was much less in orchards in which cattle were allowed to eat the fallen fruit and that fewer larvae hibernated under the bark of the trees in these orchards than in those in which fallen fruits were not removed. The collection and immediate destruction of fallen infested fruits is considered an important control measure. Warehouses and storerooms were the sources of large moth flights in Normandy, and it is therefore recommended that crates should be stored in closed buildings, preferably with windows along one side only, so that any moths that emerge congregate on the glass and can easily be destroyed.

Frèzal (P.). **Notes sur le cycle évolutif de *Laspeyresia pomonella* L. dans la région de Tlemcen en 1938.**—*Ann. Inst. agric. Algér.* **1** fasc. 1 pp. 151–179, 7 graphs, 24 refs. Algiers, 1939.

The results are given of investigations on the bionomics of *Cydia* (*Laspeyresia*) *pomonella*, L., in Algeria [*cf. R.A.E.*, A **27** 191–192], carried out at Tlemcen in 1938, when the monthly temperatures were comparable with the averages for the preceding ten years. They indicated that the moth has, for practical purposes, two generations a year, though some larvae of the first generation overwinter. In field cages, overwintered larvae collected from pear, apple and quince trees pupated from 1st April to 26th June and gave rise to adults from 19th May to 11th July. Adult males and females that were fed on molasses and water lived for up to 24 and 23 days, respectively. When they were caged with pear shoots bearing fruits, the females deposited an average of

14·5 eggs each and were not specially attracted to the fruits for oviposition. Oviposition began about two days after emergence, reached a maximum about two days later and continued for about eight days. The larvae hatched in 4–9 days, and two that were transferred to bagged fruits on the tree spent 29 and 36 days in them before leaving to pupate. Observations on larvae taken in trap bands indicated that those of the first generation descended to form their cocoons from 7th July to 17th–24th August. An increasing number of those that descended after 16th July and all those that did so after mid-August went into diapause. Larvae that transformed in the same year spent 4–22 days in the cocoon and then pupated. The pupal stage lasted 9–19 days, and the adults emerged between 19th July and 30th August. The small numbers of males and females observed lived for up to 14 and 16 days, respectively. Oviposition began one day after emergence and continued for 3–6 days, an average of 24·75 eggs per female being deposited, again with no preference for the fruits. The larvae hatched in 4–7 days; their subsequent development was not followed, but it was thought that they descend to make their cocoons from about 20th August and that almost all of them enter diapause.

[Kotlyar (L. M.).] **Котляр (Л. М.). *Hoplocampa brevis* (Kl.) in the Crimea and how to control it.** [*In Russian.*]—20 pp., 16 figs., 9 refs. Simferopol, Gos.Izd.kruimsk.ASSR, 1940. Price 50 *kop.*

As *Hoplocampa brevis*, Klug, all stages of which are described, had been infesting up to 60–80 per cent. of the fruitlets of pears in the Crimea, field observations on its bionomics and control were carried out at Simferopol in 1938 and 1939. The larvae overwintered in cocoons in the soil, some just below the surface and others at depths of down to 8 ins., and pupated about mid-March, the pupal stage lasting 15–18 days. The adults appeared above the soil when the flower buds were separating (16th–18th April) and could be observed for 8–10 days. Reproduction was parthenogenetic, as no males were found among the several thousand adults examined. The females contained fully developed eggs on emergence and deposited up to 37–40 each in the lower halves of the flower buds. There were not more than four eggs per bud. The larvae hatched in 6–8 days and fed within the developing fruitlets, destroying the seeds and migrating from one to another. Feeding lasted 21–23 days, and during this period individual larvae injured up to four fruitlets each. In mid-May, when they were fully fed, the larvae dropped to the ground, usually in infested fruitlets, entered the soil and constructed compact oval cocoons in which they overwintered. Some did not pupate in the spring of 1938, but remained in their cocoons until the following spring, and then pupated and gave rise to adults. Dwarf trees were less heavily infested than others and widely spaced trees than those planted close together. The larvae were parasitised by an endophagous Ichneumonid, which attacked up to 9 per cent. in one orchard in 1939, and a Braconid, which developed externally and overwintered in cocoons in the fallen fruitlets.

Covering the frozen soil beneath the trees in February or early March with a layer of straw heavily sprayed with milk of lime, or heaping snow beneath the trees and covering this with the straw, kept the soil cool and retarded adult emergence for about a week, so that the trees were in flower and past the best stage for oviposition. Low soil temperatures in spring also delay egg maturation. Other measures that caused some reduction in infestation were jarring the adults off the trees on to sheets during cool periods, spraying with 6 lb. sodium fluosilicate per 100 gals. water or with 1½ lb. Paris green and 3 lb. quicklime per 100 gals. to kill larvae attempting to enter fresh fruitlets, and collecting and burning infested fruitlets.

Bovey (P.) & Martin (Henri). **La lutte contre les vers de la vigne en 1942 et 1943.**—*Terre vaudoise* 1944 repr. 15 pp., 7 graphs. Lausanne, 1944.

Sprays tested against larvae of the vine-moths in various parts of French Switzerland in 1942 and 1943 included 1 per cent. Gesarol and 1 per cent. Nirosan [preparations in which DDT and tetranitrocarbazole, respectively, are the active agents], 1 per cent. nicotine sulphate (containing 15 per cent. nicotine), and 0·5 per cent. lead arsenate. Copper fungicides were used in all sprays, and a wetting agent in those containing lead arsenate or nicotine sulphate. Of the two moths, *Clysiana ambiguella*, Hb., was generally far more abundant than *Polychrosis botrana*, Schiff. The first application against the larvae of each generation was timed by the flight of the moths and followed by a second where necessary. Against the first generation in 1942, Nirosan gave 69–100 per cent. control and proved superior to nicotine sulphate in all the tests in which the latter was used, and to lead arsenate in four out of five localities. Gesarol gave inconsistent results, owing to certain physical defects in the product that rendered it unsatisfactory in suspension. Against the second generation, Nirosan was almost as effective as nicotine sulphate, which gave 67–87·5 per cent. control, and superior to Gesarol in most cases, even when a quality of the latter giving a good suspension was used and the spray liquid was directed to the clusters of berries. In a subsidiary test, the addition of a wetting agent greatly increased the efficiency of Gesarol. In 1943, Nirosan and Gesarol were far superior to lead arsenate against the first generation, and Gesarol with a wetting agent was almost as effective as Nirosan. Nicotine sulphate with a wetting agent was usually rather less effective against the second generation than Nirosan or Gesarol.

Gesarol and Nirosan dusts were also tested in both years ; they proved only slightly inferior to the sprays, and Gesarol was almost as effective as Nirosan.

Roonwal (M. L.). **On a new Phase Character, the metasternal Interspace, in the Desert Locust,** *Schistocerca gregaria* **(Forskål) (Orthoptera, Acrididae).**—*Proc. R. ent. Soc. Lond.* (A) **21** pt. 1–3 pp. 13–15, 2 figs., 3 refs. London, 1946.

Examination of a series of specimens of *Schistocerca gregaria*, Forsk., in India showed that adults, particularly males, of the phases *gregaria* and *solitaria* could be distinguished from each other by the size and shape of the metasternal interspace. In phase *solitaria*, the "metasternal index" obtained by dividing the maximum width at the anterior end of the interspace by the minimum width was about 2·8 in males and 1·5 in females, whereas in phase *gregaria* it was about 1·2 in both sexes.

Sixty-fourth Annual Report (New York State Agricultural Experiment Station) for the Year ended June 30, 1945.—74 pp. Geneva, N.Y., 1946.

The section of this report dealing with the work of the Division of Entomology (pp. 30–40) comprises short accounts of a number of investigations. In Biology and Control of the Scurfy Scale (p. 32), J. L. Brann jr., discusses the spread of the scurfy scale [*Chionaspis furfura*, Fitch] on apples during the last few years. He states that certain varieties of apple, frequently considered as more or less immune, may develop serious infestations, the data indicating that there is little or no difference in the ability of scales from a single source to settle on several varieties. Wind was found to be an important carrier for the crawlers, at least to neighbouring trees, and larger insects and possibly birds

are thought to carry them to more remote trees. The Coccinellids, *Chilocorus stigma*, Say (*bivulnerus*, Muls.), and *Pentilia* (*Microweisia*) *misella*, Lec., were effective predators, the Aphelinids, *Physcus varicornis*, How., and *Aphytis fuscipennis*, How., parasitised as many as 30 per cent. of the scales, and mites destroyed the eggs of 40 per cent. Sprays are effective against the eggs at the dormant and delayed-dormant stages and against the young nymphs after the fruit has set, either at the calyx period or when curculio sprays are applied [about eight days later]. The highly refined paraffin oils were more effective than naphthenic oils for dormant and delayed-dormant treatments, and there was practically no difference in control between these two times of application. A 0·5 per cent. emulsion of a paraffinic type of summer oil was very effective against the nymphs.

In Control of the European Red Mite, *Paratetranychus pilosus*, C. & F., with Sprays and Dusts (p. 33), R. W. Dean states that *P. pilosus* continued to be an important pest of apple in the east of the State. In field tests with 21 dormant and semi-dormant treatments in 1944, dinitro compounds gave better control in lubricating oil than in water, and the effectiveness of a dormant spray of 3 per cent. oil was increased by the addition of a dry powder containing 40 per cent. dinitro-o-cresol [*cf. R.A.E.*, A **32** 92]. Applications of oil alone were more effective at the green-tip or delayed-dormant stages than at the dormant stage, and most effective at the pre-pink stage, just after the eggs had hatched. Applications of tank-mixed paraffinic oil at concentrations of 1 and 2 per cent. at this time gave excellent control, the second being the most effective of all the treatments used in the dormant and early spring periods. A water suspension of DDT applied at the pink stage gave practically no control [*cf.* **32** 386].

Control of Oriental Fruit Moth [*Cydia molesta*, Busck] on Quinces (pp. 33–34), by E. H. Wheeler & A. A. LaPlante jr., contains information already noticed from another source [**34** 249]. It is concluded that although DDT and Ryanex are very effective against *C. molesta*, lead arsenate must be used in the sprays that are timed to control the plum and quince curculios [*Conotrachelus nenuphar*, Hbst., and *C. crataegi*, Walsh] as well, since DDT is ineffective against these weevils.

In Control of the Spittle Insect as a Strawberry Pest (p. 34), F. G. Mundinger reports that the spittle insect [*Philaenus leucophthalmus*, L.] curls the leaves of strawberry and seriously stunts the plants. In tests of treatments against it on strawberry or on lucerne, which is often heavily infested, dusts containing 0·75–1 per cent. rotenone gave excellent control. A 3 per cent. DDT dust, though less effective, gave good control, and sprays containing rotenone were satisfactory, but neither nicotine nor Lethane [an aliphatic thiocyanate] in sprays or dusts controlled the insect. It was found that the insecticides should be applied against the young nymphs as the older nymphs and adults are difficult to kill.

In Use of inorganic Insecticides for Cabbage Worm Control (p. 35), G. E. R. Hervey gives the results of experiments to determine the best diluent for dusts of lead arsenate or cryolite applied to cabbages against the imported cabbage worm [*Pieris rapae*, L.], the diamond back moth [*Plutella maculipennis*, Curt.] and the cabbage looper [*Plusia brassicae*, Ril.]. Dusts containing 25 per cent. lead arsenate were much more effective in pyrophyllite or soapstone nonfibrous talc than in fibrous talc, and the addition of 2 per cent. highly refined lubricating oil or soy-bean oil slightly improved control. Cryolite in pyrophyllite (50 : 50) gave poor control with no adhesive, but better control than any other mixture when 2 per cent. lubricating oil was added, though it did not flow through the duster freely. Analysis of the lead and arsenical residues on cabbage plants dusted four times in a dry season, with the last application on 22nd September, showed that both were far below the legal tolerance based on the total weight of cabbage in each head.

In Pea Aphid as a Factor in growing Market Peas on Long Island (pp. 35–36), H. C. Huckett reports that experimental evidence collected during six seasons failed to prove that the pea aphid [*Macrosiphum onobrychis*, Boy.] was an important factor in the spread of mosaic disease, the results tending to show that mosaic may be severe even though the insect is controlled. A dust containing 0·75 per cent. rotenone was effective against the Aphid, and two or more applications increased the crop by 33 per cent. in some cases. In some seasons the best results were secured by pre-blossom treatments, and in others by applications while the peas were in flower, and it is concluded that the time of treatment should be governed by the progress of the infestation on the peas.

In Study of the Biology and Control of the European Chafer as this applies to the Nursery Industry, ornamental Plantings, and Turf Areas (pp. 37–38), F. L. Gambrell & E. H. Wheeler report that further tests with ethylene dichloride against larvae of the European chafer [*Amphimallon majalis*, Razoum.] on roots of nursery stock in soil balls wrapped in burlap [*cf.* **31** 301] showed that an aqueous solution did not give satisfactory control at low dosages, short exposures and low temperatures, but was more effective when the same dosages were used at higher temperatures and for longer exposure periods. A solution of 5 cc. of a mixture of ethylene dichloride and ethylene dibromide (9 : 1) per U.S. gal. water was as effective against third-instar larvae as one of 20 cc. ethylene dichloride per U.S. gal., and gave a more rapid kill. A spray of ½ lb. DDT per 100 U.S. gals. water was toxic to adults of *A. majalis*, but as it did not kill them for some days and some of the females deposited eggs before dying, it was of doubtful value. Lead arsenate applied to the soil at the rate of 1,500 lb. per acre still showed a high degree of control of the larvae three years later, but lower rates were less effective; DDT used at 50 lb. per acre gave promising results. Certain strains of milky disease were very effective in killing larvae under laboratory conditions, and several acres were inoculated with spores in the spring of 1945.

The section on plant pathology (pp. 40–52) includes Investigations on Control of Hop Insects (p. 48) by R. O. Magie. He reports that in small-scale tests, a 5 per cent. DDT dust applied uniformly over the soil at the rate of 50 lb. per acre just before the eggs of *Hydroecia immanis*, Gn., hatched, killed over 90 per cent. of the young larvae [*cf.* **28** 431], and that soil injections of 10 cc. dichlorethyl ether per hop hill killed up to 95 per cent. of the older larvae without injuring the plants.

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(446) Wt. P5/3779 7/47 S.E.R. Ltd. **Gp. 432.**